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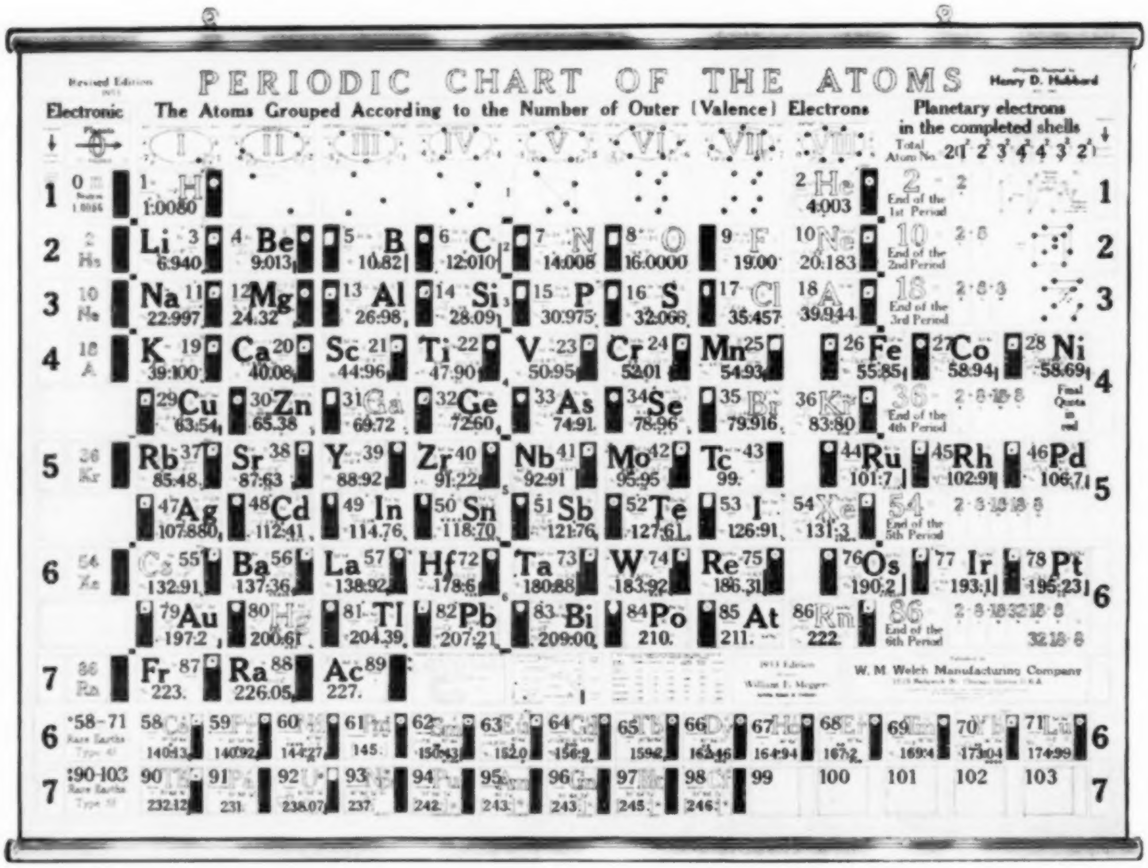

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Panic, Fear, and the Human Mind

• By the Staff of "The Keystone Defender"
OGONTZ CENTER, STATE COUNCIL OF CIVIL DEFENSE, HARRISBURG, PENNSYLVANIA

We are glad to present to our readers this timely article. We reprint it from the September, 1952, issue of "The Keystone Defender" because it is the most sensible and most thought provoking short discussion we have seen relative to this phase of Civil Defense.

You should not overlook this article.

●

There is no established pattern by which we can pre-determine exactly how *all* people will react under stress. We know that Fear is the basic cause of panic; that Fear frequently comes from a lack of knowledge.

Fear is often the product of rumor and propaganda; it is a factor which tends to lower our "will to resist." As such, it is of great assistance to the enemy. It is reasonable to suppose, from the past record, that Fear is a weapon he will try to use to the maximum.

It has been said that in Hiroshima 20,000 people were killed by panic alone, being trampled down, pushed off bridges, or needlessly abandoned. In this country, too, great numbers of casualties could result from hysteria and fear. In fact, it is likely that the number of such casualties would be high in comparison with those caused directly by an attack. Panic MUST be controlled. Much may be done in advance by dispelling underground fears which exist in the minds of many people, preparing them for emergency by giving them the truth about those things of which they are afraid.

Weapons of the Mind Are Effective

They can produce more casualties than any other weapon devised by man.

"Divide and Conquer" techniques:

1) Demoralize the masses,
2) Confuse the issue,
3) Stir prejudices,
4) Create doubts and fears,
5) Create dissension and discord.

Rumor

A rumor is a special kind of suggestion about something real or fictitious (a person or an event) which becomes more and more distorted as it is spread.

Rumors often coincide with our ideas and beliefs; they are often "planted" with that intention.

There are three general types of rumor:

1) *Fear Rumors*, which seem to substantiate our fears that an event may be true. (The spread of polio, the Invasion from Mars, the "End of the World," etc.)
2) *Hope or Wish Rumors*, which support our hope that a report may, or may not, be true. (The false Armistice in World War I, the hopeful belief in the accuracy of the POW lists from Korea.)
3) *Hate Rumors*, which feed our prejudices; this is the most dangerous and vicious type of rumor. (Detroit race riots, labor-management strife, etc.)

The enemy starts rumors because they breed hate, dissatisfaction, worry, and uncertainty. They can do great harm to both military and civilian morale; they can cause such disunity that chaos results. Rumor is one of the enemy's chief weapons of sabotage. Civil Defense and its leadership are very likely targets. The enemy can minimize our efforts by spreading distrust, undermining the leadership, and playing down the need for Civil Defense.

How Can Rumor Be Stopped?

1) Knowledge is the best protection against rumor. Get the FACTS.
2) Maintain a skeptical attitude; be SURE a report is true before you believe it.
3) Trace a rumor to its source; if there is not enough evidence to support it, consider it unfounded.
4) DON'T REPEAT IT: TELL YOUR INFORMANT NOT TO REPEAT IT.

There is no "percentage" in helping the enemy on the one hand, while giving time and effort to defeat him on the other.

Propaganda

Propaganda differs from rumor in the fact that it is an ORGANIZED, planned attempt to influence the thoughts and actions of others.

Propaganda is intended to change the thinking of people in some way. By playing on people's emotions and prejudices, suggestions are used to secure the acceptance of attitudes, ideas, and acts. For example, by playing on people's desire for a normal, peaceful world, the attitude is fostered that "it can't happen here," or "if they were going to strike, they'd have done it by now." Both ideas are dangerous. By appealing to basic human wants, propaganda can create dissatisfaction, dissension, discord, or inertia.

Propaganda is spread by person-to-person whispering campaigns; by propaganda books and those newspapers, magazines, and radios, which are controlled directly or indirectly by Communists or radicals; by trained agents taking advantage of opportunities with "spur of the moment" material, such as any racial clashes, or

(Continued on Page 38)

The National Geographic Society

• By Gilbert Grosvenor
PRESIDENT, THE NATIONAL GEOGRAPHIC SOCIETY; EDITOR, THE NATIONAL GEOGRAPHIC MAGAZINE, WASHINGTON, D. C.

This is a delightful article written by one of America's most distinguished Editors.

To many readers, including a few teachers perhaps, his journal IS the National Geographic Society. But this interesting account of the Society and its many activities from its early days to the present shows how misinformed such persons are.

Undoubtedly, the Society's activities and accomplishments have not always received the popular understanding and appreciation that they have deserved.

Perhaps this article will help a little.

The National Geographic Society and teachers of geography have a common aim. They seek to spread knowledge of Geography to the greatest possible extent.

The Society's journal, the *National Geographic Magazine*, is almost a textbook for teachers. Its bound volumes provide a valuable reference in thousands of school, college and university libraries. In addition, the Society's School Bulletins have been furnished free of charge for more than 30 years to 30,000 school teachers each week, upon their written request, one for each school day throughout the year.

The story of the founding and growth of this largest scientific society in the world is a fascinating account of American initiative and enterprise.

The 13th fell on Friday in January, 1888—some 65 years ago. Grover Cleveland, in the White House, prepared a message to Congress asking for prompt extension of federal financial aid for the railroads. At Washington's famous Cosmos Club, one block away, 33 men gathered "for the purpose of considering the advisability of organizing a society for the increase and diffusion of geographic knowledge."

DR. GILBERT GROSVENOR. Dr. Grosvenor came to the National Geographic Society before the turn of the century, when it was a small, scientific society, and through his energy and ability transformed it to its present world preeminence, with membership of more than two million. All members receive the National Geographic Magazine as a privilege of membership.

Mostly scientists in government service, these men warmed to the discussion. Two weeks later the National Geographic Society was chartered and its organization meeting was held. Its charter membership totaled 165, which is three less than the Society's membership today in oil-rich, sun-baked Iraq. The total membership of the Society at present is more than two million.

Keynote of the ever increasing popularity of the Society and its magazine was sounded at the beginning by Gardiner Greene Hubbard, the first president.

"I am not a scientific man, nor . . . a geographer," he said. "By my election you notify the public that the membership of our Society will . . . include that large number who, like myself, desire to promote special research by others, and to diffuse the knowledge so gained among men, so that we may all know more of the world upon which we live."

Early in 1889, there appeared a slim little periodical—the first issue of the *National Geographic Magazine*. Between its paper covers of terra-cotta shade were scholarly treatises on such scientific subjects as "Geographic Methods in Geologic Investigation," and "The Classification of Geographic Forms by Genesis." The only illustrations were weather charts accompanying an account of "The Storm of March 11-14, 1888."

Even after 10 years, the Society counted less than 1,000 members. The Magazine, having appeared at irregular intervals through most of this

period, held little attraction for non-technical readers. Numerically the membership was not expanding and its board was discouraged.

One who was not disheartened, however, was Alexander Graham Bell. Succeeding to the Society's presidency upon the death of his father-in-law, Dr. Hubbard, in 1898, the distinguished inventor of the telephone had two important ideas in mind.

The first was to engage a full-time person for editorial and promotion work. Dr. Bell sought a young man who might develop the founders' original idea of popularizing the science of geography, and who could shoulder editing and business duties that had been voluntarily performed by scientists who were very busy and frequently far away in their government fields of research.

His second conviction was that efforts should be directed not toward obtaining mere subscribers to a magazine, but toward securing members of a society who would believe in the project and help it grow steadily by mouth to mouth endorsement of its educational and scientific objectives.

In his search for someone who could aid in the development of these two ideas Dr. Bell appealed to my father, Dr. Edwin A. Grosvenor, professor of European history at Amherst College, author of two magnificently illustrated volumes, "Constantinople," and other works, and later president of the United Chapters of Phi Beta Kappa.

Dr. Bell asked my father if either my twin brother, Edwin Prescott Grosvenor, or I, would be interested in working for the Society and if one of us would take the job of Assistant Secretary of the Society and managing editor of the magazine. He informed each of us of his request.

Dr. Bell's proposition appealed to me more than to my legally minded brother, and I accepted it. I was born in Constantinople (Istanbul) and had spent my pre-college days there. My father had been professor of history at Robert College for twenty years before being called to Amherst. My life abroad and my close association with my scholarly father had given me unusual geographic interest. I had been graduated from Amherst in 1897. I was teaching in Englewood Academy for boys in New Jersey. I had been engaged originally to give instruction in French, German and Latin. The principal later assigned me classes also in college algebra, chemistry, public speaking and debating. Compared with this program, a job as editor seemed very easy.

I started to work April 1, 1899, and the next year became not only editor and director, but Dr. Bell's son-in-law. For five years Dr. Bell personally contributed to the Society the amount of my salary.

When I took the job I looked around me to see what geographic books had been tested and had continued for years to be widely read and respected. These books included Darwin's *Voyage of the Beagle*, Dana's *Two Years Before the Mast*, Joshua Slocum's *Sailing Alone Around the World*. I asked myself what there was in Herodotus' *Travels* and these books that maintained constant interest over periods of years, even centuries.

The secret of these great geographical books is the accurate, eyewitness, firsthand account, the simple, straightforward writing that seeks to make pictures in the reader's mind.

Pictures are the secret, for the mind must see before it can believe.

In those days the modern arts of photography and photoengraving were just blossoming. Here was the answer to the problem of making world geography interesting to everyone. Almost four decades before picture magazines were to become an American hobby, we began to use photoengravings to illustrate and "humanize" geography on an unprecedented scale.

HEADQUARTERS OF THE NATIONAL GEOGRAPHIC SOCIETY, 16th and M Streets, Washington, D. C. During business hours, The Society's portals are wide open to the members of The Society and to other visitors from all over the world. The more than 2,000,000 member-families of the National Geographic Society are its owners. Thousands annually visit the Washington headquarters where all exploration projects are planned and where the Magazine is prepared.

Although some members of the Board of Trustees had laughed in 1899 at the idea of a membership of 10,000, that number became a reality in 1905. The Society not only relieved Dr. Bell of the burden of paying my salary, but permitted me to employ an assistant at $60 a month. The then young man who took the job was John Oliver La Gorce, and he took a substantial cut in salary to do so.

Our team is still in harness today. I remain president and editor. Dr. La Gorce is vice-president and associate editor. We have achieved many "firsts" in the broad field of world-wide exploration and in magazine publishing. We have seen the Society's membership rise numerically to new undreamed-of heights, extending to practically every civilized country on earth. Among the Society's fact-finding and interest filled projects contributing to world knowl-

edge have been more than 100 scientific expeditions.

Across Nicaragua with Transit and Machete was the title of a story in Volume 1, 1889, by a 33-year-old naval engineer named Robert E. Peary. This same tropical traveler was destined to make a series of journeys to the top of the world, aided by the Society, and finally to carry the American flag to the North Pole.

The Society perfected the Sun Compass which Admiral Byrd called essential to the success of his first flight over the North Pole in 1926. It contributed substantially to Admiral Byrd's several expeditions to the Antarctic.

On November 11, 1935, in one of a series of flights sponsored by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, carried then Captains Orvil A. Anderson and Albert W. Stevens in a spherical gondola with nearly a ton of scientific instruments to 72,395 feet—more than thirteen miles—the greatest height attained by man before rocket and jet power.

THE WORLD'S LARGEST METEORITIC CRATER. Located in the cold, rocky wilderness of Ungava peninsula in northern Quebec, Chubb Crater, discovered by prospector and frontiersman Frederick W. Chubb, has been found by Dr. V. Ben Meen of the Royal Ontario Museum of Geology and Minerology to be the world's greatest meteoritic depression. On an expedition sponsored by the museum and the National Geographic Society, Dr. Meen established the meteoritic origin of the crater, whose almost round lake is more than two miles in diameter, with a water depth of 825 feet.

The same year the Society also cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which the scientist-explorer descended in his bathysphere to the record depth of 3,028 feet.

Early in 1939 archeologists representing the Society and the Smithsonian Institution discovered the oldest work of man in the Americas for which we have a date. It is a slab of stone engraved in Mayan characters with a date which corresponds to November 4, 291 B.C. (Spinden Correlation). It antedates by 200 years anything heretofore dated by man in America, and reveals a great center of early American culture.

Society sponsored expeditions have pushed back the horizons of history of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating ruins in that region, they have solved secrets of history. The world's knowledge of volcanoes, of caves, of icefields and glacial systems and of many other phenomena of nature has been advanced by expeditions planned and supported by the National Geographic Society.

One recent expedition of this nature was that jointly sponsored by the Society and Canada's Royal Ontario Museum to Chubb Crater, the great 11,500-foot circular scar in the rocky wastelands of the Ungava peninsula in northern Quebec. This expedition in 1951, led by Dr. V. Ben Meen, director of the museum, established that Chubb Crater is the world's largest known crater of meteoritic origin.

Of tremendous scientific importance are two Society projects now under way. In cooperation with the University of Miami (Florida) a study is being made of the plankton in the Gulf Stream. This investigation into the vast "meadows of the sea" that provide basic food for marine life can be of great value to the fishing industry and may one day aid in providing food for the growing population of the world.

Across the North American continent, at California's Mt. Palomar observatory, the Society is working with the California Institute of Technology on a four-year project for mapping the heavens to provide astronomers and other scientists with the first comprehensive "sky atlas" or series of photographic maps of the sky ever made. When it is finished the sky atlas may become available to observatories throughout the world. The 1,870 star maps in this atlas will include celestial bodies as distant as 300,000,000 light years from the earth. Many new comets and asteroids in our own solar system have turned up already in the photographic plates made by the 48-inch Big Schmidt telescopic camera employed in the sky-mapping work.

Branching off toward the field of pure science, the Society has photographed recent total solar eclipses to study the "Einstein Shift," the theory advanced by Dr. Einstein that light passing through space is attracted by celestial bodies just as if it had weight. Dr. George Van Biesbroeck, noted Yerkes Observatory astronomer photographed the star field back of the sun during the Bocaiuva, Brazil, eclipse of 1947 and the Khartoum, Anglo-Egyptian Sudan eclipse of 1952 for this purpose.

By photographing the star field during an eclipse, when the sun is obscured, and then photographing the same star field at night some months later, Dr. Van Biesbroeck is able to record the minute apparent displacement of the images of these stars at the time of the eclipse, resulting from the bending of the rays of starlight as they pass the sun. If the bending is as much as predicted by Einstein, it supports the theory of

relativity*. This proof can be of immense importance in nuclear and theoretical physics.

The member families of the Society, residing in some thousands of cities, towns and the countryside throughout the Western Hemisphere, gain a feeling of personal participation in these expeditions, for a share of their $5-a-year dues goes to forward such important work. Young or old, in the city or on the farm, each member helps further to increase and diffuse geographic knowledge.

Of more than 300,000 members outside the United States and its territories and possessions, nearly 105,000 live in the United Kingdom and more than 63,500 in Canada; 9,000 live in Brazil; 7,000 in Belgium. Others are scattered throughout the world. Mozambique, Malta and Malaya; Pakistan and Portugal are among the numerous countries that share with Iraq the distinction of having more members now than there were in the entire organization when it was founded!

Before delivery became impossible for political reasons, three member's Magazines traveled first by train, then by ocean liner, by river sampan, by coolie courier, and finally by camel and yak caravan to their homes in Lhasa, Tibet. Prosaic address stencils are magic keys to palaces in India, tea plantations in Malaya and rubber settlements in the jungles of the Amazon.

A MASSIVE STONE HEAD MEETS ITS MEASURE. Dr. Matthew Stirling of the Smithsonian Institution, measures one of the immense lava "La Venta" heads, carved in lava by an unknown, discovered by the National Geographic Society-Smithsonian expeditions to southern Mexico. On one of these expeditions a slab of stone engraved in Mayan characters with a date corresponding to November 4, 291 B.C. (Spinden Correlation), the oldest known recorded date of man in America, was found.

With the Magazine members of the Society receive each year four or five large, ten-color map supplements covering major portions of the world. These maps are painstakingly prepared by the Society's own experienced cartographers who spend months in research before drawing a single line. Nearly 125 different maps have been distributed since 1899.

These maps form a standard source of reference in member homes, schools and libraries. Throughout World War II they were of vital assistance to Allied Armed Forces. The War Department requisitioned more than a million copies, and the Navy also acquired large numbers.

A cabinet of National Geographic maps hung in President Roosevelt's wartime study in the White House, likewise in the offices of General Marshall, Admiral King, General Eisenhower and other military leaders. Prime Minister Winston Churchill so admired Mr. Roosevelt's cabinet that the latter requested the Society to make a duplicate which he presented as a Christmas gift to the British war leader.

In addition, special, timely black and white maps are distributed along with news bulletins of geographic interest by the Society's news service. The bulletins and maps are sent to newspapers, wire services and radio stations throughout the world. Maps showing Korea and Indochina in detail have been distributed since the outbreak of new trouble in the Far East.

The news bulletins themselves are valuable in updating editors, writers and commentators on the status of various parts of the world. They also provide valuable source material on commodities, geographic points of interest and scientific advances.

The Society also aids the newspapers as an authority on geographic spelling, since the three great press associations, the Associated Press, United Press and International News Service accept as official place names as they are found on National Geographic maps.

"What will you do when you have covered the entire world?" we are sometimes asked. "Don't you expect to run out of fresh material?"

It is easy to give a definite "No" to reply to the question. Geography is constantly changing, for the world is never static. Cities grow and diminish, international political borders are revised, rivers swerve into new courses, customs and costumes are altered over the years. There is every indication that the National Geographic Society's blue, green and brown flag —representing the earth, sea and sky and designed by Mrs. Grosvenor 53 years ago—will continue to fly with ever-renewed vigor for a long, long time to come. ●

★ ★ ★ ★ ★

"It is easy to like the young because they are young. They have no faults, except the very ones which they are asking you to eradicate: ignorance, shallowness, and inexperience. The really hateful faults are those which we grown men and women have."

—GILBERT HIGHET
The Art of Teaching

*Since this was written Dr. Van Biesbroeck has completed his second set of photographs and a careful comparison with the eclipse pictures shows an image displacement, or shift, averaging 1.70 seconds of an arc, plus or minus .10 for possible error. Dr. Einstein's prediction of 1.75 thus falls within the range of these results.

Active Nitrogen

• By Sister Helene Ven Horst, Ph.D., (*State University of Iowa*)
DEPARTMENT OF CHEMISTRY, MARYCREST COLLEGE, DAVENPORT, IOWA

One of the phenomena characteristic of electrical discharge in certain gases under low pressure is a so-called "afterglow," which lasts for some time after the current has been discontinued.

This paper summarizes some of the remarkable properties of active nitrogen and nitrogen afterglow, and outlines the more acceptable theories that attempt to explain them.

Interesting and unusual phenomena characterize many of the reactions in electrical discharge tubes. There are produced atoms, radicals and compounds which are not stable under the usual conditions, and it is principally through a study of the spectrum and the chemical reactions in the discharge tube that a more complete knowledge of their composition is obtained. Although in many instances the results are unusual, nevertheless the discharge tube itself is certainly not unusual. Commercially the neon sign capitalizes on these phenomena.

Fundamentally there are four types of impacts by the electron as it passes from the cathode through the gas under low pressure. 1) There may be an inelastic impact in which both the electron and the molecule have no great change in energy but there is merely a change in the direction of their motion. 2) Electrons of greater speed bring about an ionization impact. This results in the production of a positive ion and a slow-moving electron in addition to the impacting electron. 3) There may result an impact which leaves the molecule in an excited, energy-rich state. Such a molecule will return to its ground state or normal condition with the emission of radiation. 4) Still another effect of electron impact is the direct dissociation of the molecule into normal or excited atoms.

It is possible in some instances where conditions are controlled and where an accurate knowledge of dissociation energies, ionization and excitation potentials is available, to bring about specific reactions in discharge tubes. However, in many instances the reactions are so complex that it appears that there are probably several mechanisms involved and that it is impossible to describe the reaction as belonging to any one specific type.

A rather unusual phenomenon characteristic of electrical discharge in certain gases is the so-called afterglow. When the current which is passing through a luminous gas at low pressure is interrupted, in some instances the gas will continue to glow or phosphoresce even though the passage of electricity has been stopped. This phenomenon was first observed in oxygen by Becquerel as early as 1859. Since then innumerable investigators have studied the problem of afterglow in nitrogen in an effort to understand the underlying principles. A lack of sufficient detail in describing the very early investigations makes a comparison of these results with current information somewhat difficult. In some instances the afterglow was observed in air, at other times it was produced in several gases in which oxygen was present. The question arose as to whether the afterglow is produced in the body of the gas or on the glass wall of the vessel. It is even doubted if these early investigators really observed the same "nitrogen afterglow" that the present term connotes, since there are several kinds of afterglow depending upon the condition of excitation, the purity of the gas, and the size and shape of the discharge tube. The afterglow has been described as "a beautiful chamois-yellow mist" which lasts from several seconds to as long as six hours after the current has been discontinued.

No attempt will be made to discuss in detail all the theories which have been proposed to explain the phenomenon of nitrogen afterglow. It is the purpose of this paper to summarize some of the remarkable properties of active nitrogen and to associate them with the more acceptable theories.

At the beginning of the twentieth century, interest in this phenomenon was stimulated because of the diversified experimental conditions which appeared essential in the production of the nitrogen afterglow. Some experimenters stated the phenomenon depended upon the presence of minute traces of water vapor or oxygen; others held that small additions of hydrogen, carbon dioxide, water vapor or oxygen destroyed the afterglow. The method of electrical discharge varied likewise. A condenser and spark gap appeared then to be the only method for producing the afterglow which occurred only if the nitrogen was almost free from oxygen. Pure nitrogen gave no glow whatsoever with an ordinary induction coil. In one instance it was found that even though all experimental conditions were identical, the glow could not be produced unless an appropriately sized discharge tube was used.

Although traces of oxygen proved essential for the production of the afterglow, it was found that as much as two per cent destroyed this effect. The addition of unexcited nitrogen to glowing nitrogen increased the instantaneous emission. A fivefold increase in total pressure produced a fivefold increase in brightness. A greater increase in intensity was also observed if the glowing gas was cooled by liquid air. Part of this increase in intensity by cooling could be accounted for by the increase in concentration of the active nitrogen. The best barometric condition for the production of the nitrogen afterglow is a few millimeters of pressure, because at higher pressures the collision with ordinary nitrogen molecules destroys the glowing substances.

A very important factor in the production of the afterglow is the condition of the glass walls of the

discharge tube. The glow cannot be produced if reconversion of the active nitrogen into normal nitrogen takes place on the surface of the walls. If the glass is poisoned or decatalyzed with traces of impure gases, principally oxygen, or with substances such as Apiezon oil, metaphosphoric acid, or concentrated sulfuric acid, this conversion will not take place at this point but rather in the volume of the vessel. In such cases the afterglow is best produced in the purest nitrogen, and then the addition of oxygen has no favorable effect in promoting the active nitrogen phenomenon. The absence of other than N_2 bands in the spectrum indicates that there is no reaction between the active nitrogen and the impurity present.

Numerous experiments have been performed in an effort to study the effect of the condition of the walls in the production of nitrogen afterglow. Strong preliminary heating of the discharge tubes *in vacuo* or even in an atmosphere of nitrogen destroys the glow; however heating the tube in as little as one millimeter of oxygen restores it. The glow could not be produced in silica vessels which had been strongly heated and cooled. Glowing nitrogen at 0.3 mm. pressure was scarcely visible at all in a Pyrex glass which had been heated to 575° C. for an hour and then cooled; however, after prolonged action the glow became as visible as that in an untreated tube. Discharge tubes which were baked out, allowed to cool, and left exhausted for a week showed no spontaneous recovery of the tube. The addition of air or carbon dioxide at atmospheric pressure and temperature for twenty-four hours did not produce the glow. These tubes were subsequently filled with distilled water, let stand overnight, and exhausted in the presence of phosphorous pentoxide after which the wall effect was partially restored.

Partly as a result of the diversified methods and conditions which have been used in the production of nitrogen afterglow, a correspondingly large amount of information has been accumulated concerning the properties of this active form of nitrogen.

When active nitrogen is heated or subjected to a small electric current, the visible glow disappears or is greatly weakened but the gas retains its activity. When nitrogen flows through a tube the central portion of which is heated, the glow is extinguished in the heated portion but recommences when the gas reaches the cooler part of the system. It is assumed that a three-body recombination in the volume takes place in the dark phase and that the reaction leading to the excitation of visible light is interrupted by the heating or the electric current. The mechanism of this interruption might be the destruction of the metastable molecules which the recombination process produces.

Ordinary metals held in active nitrogen are unaffected; however, if the metal is warmed or held in the discharge, the metal starts glowing, presumably because the active nitrogen begins to deliver energy to it. The explanation is that ordinarily no reaction takes place on the metal surface because the metal immersed in active nitrogen becomes conditioned and prevents access of the atoms, ions or electrons to it. If the conditioning is destroyed by warming it or placing it close to the discharge, then the reaction on the surface starts and the released energy raises the temperature to a glowing heat. Pieces of sheet gold, copper, silver and platinum are made red hot or even melted by exposing them to active nitrogen produced in a low-pressure discharge. The nitrogen gives its energy to the metal which remains unacted on. Those metals which remain bright do not react with the nitrogen but serve only as catalysts. The active nitrogen is converted and gives up its energy by a process which occurs at the surface of the metal. Chemical action on metals like iron and nickel have not been examined successfully. However the black coating which forms on zinc and cadmium is presumably the nitride. Sodium also reacts to form the nitride but this reaction is less energetic than that with the previous metals. The volume of nitrogen absorbed is small and the formation of ammonia has not been obtained.

The chemical activity characteristic of active nitrogen has likewise been observed where nitrogen is in the proximity of radioactive substances.

Reactions which have been brought about in the discharge tube give evidence of the intense reactivity of active nitrogen. The modified nitrogen changes yellow phosphorous to the red variety, and it combines with mercury to produce an explosive compound. With acetylene the active nitrogen forms cyanogen. It has been shown that molecular hydrogen does not react with active nitrogen; however, nitric oxide reacts to form nitrogen peroxide.

It has been observed that the removal of all charged bodies from a stream of active nitrogen is without effect upon its chemical properties or the concentration of the chemically active species. The complete removal of ions from the glowing gas does not diminish its luminosity or its ability to develop the spectra of other substances. The current which passes between two electrodes of different areas bathed in the afterglow is proportional to the area of the cathode. Therefore the conductivity of active nitrogen is due to emission of electrons by the metal either photoelectrically or else by bombardment with the luminous gas. If the electrodes are placed in thin quartz vessels surrounded by, but not actually containing glowing nitrogen, no current passes even under the most varied conditions. When the glow is destroyed by heating the gas before it reaches the electrodes, the conductivity also vanishes, but the concentration of chemically active nitrogen remains unchanged. This would indicate that a modification of nitrogen is present which is chemically inactive but which is able to cause the metals to emit electrons.

Another unusual feature of the afterglow of nitrogen was observed in the spectrum following discharge. At low pressures, with a mixture of helium and nitrogen, there resulted a strong afterglow but only the molecular spectra were observed; at high pressure nitrogen lines could also be observed.

Although the methods of producing the nitrogen afterglow and the specific properties are universally accepted, nevertheless the nature of the reaction is still a controversial point. According to one theory there are present two types of afterglows—the long-lived

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Silicon - The Cinderella of the Elements

• By R. R. McGregor, Ph.D., (*University of Illinois*)
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This article, by an acknowledged authority, is a brief introduction to the chemistry of the interesting organosilicon compounds that in recent years have found many new and useful applications.

Unconventional in structure and in properties, they may be prepared as liquids, greases, resins, or rubbers. In the home they may clean your eyeglasses, "grease" your bread pans, polish your furniture, or soothe an irritated skin. Their industrial use is increasing yearly.

The present position of Silicones as new and unique synthetic products has stimulated inquiries about the long-known element Silicon. By what turn of fate has this component of gritty sand and bricks suddenly emerged as the essential part of sparkling oils, heat resistant resins and rubber-like materials? There is a Cinderella touch to the story, for it appears that in its new and more elegant sphere Silicon is going to "live happily ever afterwards."

But the change from the hovel to the palace has not been as sudden as many seem to think. It has taken long years and the art of many "chemical tailors" to fashion and bedeck the fireside waif to the point where she can appear in the new surroundings with assurance and dignity.

Growth of Organosilicon Chemistry

Originally, the lot of silicon was to act as one of a number of elements in cobblestones, mortar and fire-brick. There was little distinction to be gained by association with clays and mud; even the name "silicon" had yet to be coined.

In 1824 the Swedish chemist Berzelius reported that he had isolated, from quartz sand, an element previously unknown. He called it "Silicium." It was a black, unprepossessing solid with a metallic luster. But it took part in some surprising reactions. One of the most surprising was its ability, when heated, to react with chlorine. Instead of forming a salt, as chlorine does with soda, potash or lime, a low boiling (57.6°) liquid was formed which was chemically reactive. This liquid proved to be the "open sesame" for knowledge of reactions of silicon.

When exposed to moist air this liquid gave off hydrochloric acid while the silicon was transformed to silica:

$$SiCl_4 + 4H_2O \longrightarrow 4HCl + Si(OH)_4 \longrightarrow SiO_2 + 2H_2O.$$

Simply mixing it with alcohol brought about exchange of the four chlorines for as many alcohol groups:

$$SiCl_4 + 4C_2H_5OH \longrightarrow Si(OC_2H_5)_4 + 4HCl.$$

The latter compound was a liquid, boiling at 165.5° and possessed of an ester-like odor. It was only slowly hydrolyzed by pure water:

$$Si(OC_2H_5)_4 + 4H_2O \longrightarrow 4C_2H_5OH + Si(OH)_4 \longrightarrow SiO_2 + 2H_2O.$$

Other groupings such as ammonia or even hydrogen could be induced to replace the chlorine; but the resulting product would always react with water. The end result was always silica, and Cinderella returned to the fireside.

In 1863 (some 40 years after Berzelius had isolated silicon) the first silicon compound was prepared in which the element was linked directly to carbon. The carbon-silicon linkage was not affected by water and it proved to be surprisingly stable to heat. This opened up new possibilities for silicon. In the silicon-containing compounds known before, water could hydrolyze all the groups bonded to silicon, and silica, or sand, was the end product. But now, if even one nonhydrolyzable organic group were present, the compound could not revert to silica, whatever else might happen.

The nature of these compounds that could not form silica was studied for years by the "chemical tailors"

A SPRAY-ON RESINOUS COATING especially designed for bread pans, Dow Corning Pan Glaze cures to a hard, glossy film to which baked bread cannot adhere. Pan Glaze keeps bakeries clean by eliminating grease and its consequent smoke and carbonized residue.

in an attempt to determine just what was formed. There was a dim recognition that these oily or glue-like compounds were very large molecules or polymers, even as silica itself is. But the properties were not those of silica. Many of the compounds were soluble in organic solvents and yet they remained unaffected by heat that would destroy most organic compounds. They were thin oils or brittle glues. Not enough was known about polymers at that time to suggest that studies in this direction would be fruitful.

In the 1920's, progress was being made in the study of methods for preparing very large organic polymers. When, in the early 1930's, these principles were applied to the organosilicon compounds it was found that they, too, could form very large polymers.

The large polymers were found to have properties that would not necessarily be expected from a study of the small polymers and they were not at all like the volatile intermediates. These properties found such a wide variety of applications that the "Silicones," as the polymers were now called, became more and more in demand. They are now produced in quantity and are used in some fashion in practically any industry one can name. "Silicon" once more returned to the palace and has become a recognized member of the royalty of elements that have been responsible for so many of the advances in technology in recent years.

Preparation of Silicones

A knowledge of the successive steps by which silicones came into being should make it plain that two general types of groups should be present on the silicon atom if a silicone (as contrasted with silica) is to be prepared. One type of group should be able to be hydrolyzed upon contact with water so that the siloxane bonding can be formed. Such groups are halogen (X), alkoxy or aryoxy (OR), amino (NH_2), and hydrogen. Thus:

$$2\ {-SiCl} + 2H_2O \longrightarrow 2\ {-SiOH} + 2HCl \longrightarrow Si{-O-}Si{-}$$

The second type of group should not hydrolyze with water, thus making impossible the formation of orthosilicic acid ($Si(OH)_4$) which would revert to silica (SiO_2):

$$2R_3SiCl + 2H_2O \longrightarrow 2R_3Si(OH) + 2HCl \longrightarrow R_3SiOSiR_3 + H_2O.$$

Preparation of Intermediates

In practice, the intermediates commonly prepared are those containing both chlorine and organic groups. There are a number of ways of doing this, of which three are of commercial importance:

1. *The Direct Process.*—Finely ground silicon, to which is added copper powder (as catalyst), is tumbled in a reactor at about 300°C. Through this is led methyl chloride gas. The reaction that takes place may be represented as:

$$Si + 2CH_3Cl \longrightarrow (CH_3)_2SiCl_2.$$

This product is a liquid boiling at 70°. Other products are formed at the same time, but, in general, this is the product desired.

So far this simple method is applicable, in a commercial sense, only for the preparation of methyl-containing intermediates.

2. *The Grignard Method.*—This well-known laboratory method has been applied commercially. While it is not as simple as the first method, it is more versatile in the type of products that can be prepared.

The first step is the preparation of the so-called "Grignard reagent" by reacting an organic chloride with metallic magnesium under ether:

$$RCl + Mg \longrightarrow RMgCl.$$

The ethereal solution is then dripped into an ethereal solution of silicon tetrachloride:

$$RMgCl + SiCl_4 \longrightarrow RSiCl_3 + MgCl_2.$$

More than one organic group can be added to the silicon by increasing the quantity of "Grignard reagent" used.

The solution is filtered and distilled to obtain the product.

3. *The Olefin Addition Method.*—This method depends on the fact that a silicon compound in which a hydrogen is attached to silicon will add to an olefin under the influence of heat or a peroxide catalyst:

$$Cl_3SiH + CH_2{=}CH_2 \longrightarrow Cl_3SiCH_2CH_3.$$

It will be noted that since the organic group must originally contain a double bond it is not possible to prepare methyl compounds by this method.

SILASTIC (white) stays soft and flexible after 90 days of accelerated aging at 300°F. A high grade synthetic organic rubber loses almost all of its flexibility and becomes a brittle plastic after one day at 300°F.

Polymerization of Intermediates

Having at hand, by these processes, intermediate compounds containing silicon, organic groups and chlorine, it is possible to form polymers and copolymers by the use of the hydrolysis and condensation reactions described above. Those compounds having only two chlorines (or "functional groups") attached to silicon can form linear polymers that may be of very large size:

$$\text{(1)}\quad \mathrm{Cl}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{Cl} + 2H_2O \longrightarrow \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} + 2HCl$$

$$\text{(2)}\quad \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} + \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} \longrightarrow \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} + H_2O$$

$$\text{(3)}\quad \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} + \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH} \longrightarrow \mathrm{HO}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{O}\underset{R}{\overset{R}{\mathrm{Si}}}\mathrm{OH}$$

And so the process can continue, theoretically, until all the OHs are consumed by this reaction.

These linear polymers are liquids and constitute the well known "silicone fluids" of commerce. The viscosity of the fluid is a function of the polymer size. Other properties are affected by the nature of the "R" groups.

Now, if the intermediate has only one organic group and three chlorines, it will be apparent that more complicated polymers can result:

$$\mathrm{Cl}\underset{Cl}{\overset{R}{\mathrm{Si}}}\mathrm{Cl} + 3H_2O \longrightarrow \mathrm{HO}\underset{OH}{\overset{R}{\mathrm{Si}}}\mathrm{OH} + 3HCl.$$

The condensation of these OH groups with similar OHs on other molecules gives a very tightly bound or "cross-linked" polymer. In general these polymers have a "rosinous" feel. Normally they are poorly soluble in organic solvents and are very brittle. Solubility and flexibility can be imparted by mixing intermediates containing both two and three chlorines and hydrolyzing the mixture. The percentage of cross-links is thus reduced, bringing about more flexibility and improved solubility. This is the technique used for the preparation of silicone resins. The final properties are dependent on the polymer size, the nature of the R groups and the amount of cross-linking.

The foregoing statement shows the mechanism of polymer preparation. For the preparation of grease-like materials the fluids are mixed with very finely divided silica or special types of soap.

The rubbers are prepared from the fluids by reacting them, in the presence of inorganic fillers, with an organic peroxide as vulcanizing agent.

Resins for paints, electrical insulation, laminating, or molding are prepared from the crosslinked polymers. Variation in the amount of cross-linking and in the nature of the organic groups attached to silicon bring about the development of particular properties for particular application.

The foregoing statement has shown the unconventional structure present in silicones. But, actually, the remarkable thing about these polymers is not so much their unconventional structure as their unconventional properties. These properties are the wide temperature range of fluidity, the small change of viscosity with change of temperature, oxidation stability, water repellency, good dielectric properties, low surface tension and high compressibility, to mention only some of the more evident. These and many other unexpected properties have resulted in the development of a great variety of applications.

One thing that has contributed to the multiplicity of application is that the silicones are prepared in different forms: as liquids, greases, resins, or rubbers. They are all much more resistant to heat than their organic counterparts, and many of them retain their properties at temperatures as low as -50°F. and some of them as low as -100°F.

As a class the silicones are very water-repellent, a property that is useful in the treatment of ceramic ware, glass, textiles and electrical apparatus. Some of them are not compatible with rubber and many plastics. Because of this they are used to treat metal molds for the molding of rubber and plastics. The finished piece does not stick to the mold. Bread pans can be treated with a silicone in such a fashion that no greasing of the pans is needed for some hundreds of bakings. The loaves fall cleanly from the pans. Certain types can eliminate foam in industrial and domestic applications. Others can be used to polish cars and furniture. Some are used to lubricate machinery, and others function as components of salves that relieve skin irritations.

The silicone polymers have excellent dielectric properties. This, combined with the water-repellency and heat stability, has brought about their wide use as impregnating resins in the manufacture of electrical motors and similar equipment. Silicone insulated motors have as much as ten times the life of motors having conventional insulation.

The flexible and resilient silicone rubbers will retain their properties over a temperature range of -100°F. to 500°F. The rubbers can be used as impregnants, coatings, or as solid, molded or extruded pieces.

Conclusions

What has been said has been intended as an introduction to the new and strange chemistry of the silicones. Some may take exception to the statement that it is "new"; for it has been growing for over 100 years. Nevertheless, new information is constantly developing. And the new information is often "strange" when compared with the chemistry of conventional carbon compounds. This is not the place to discuss the new findings, but one taking up the silicones as a field of study can look forward to new, strange and challenging developments. ●

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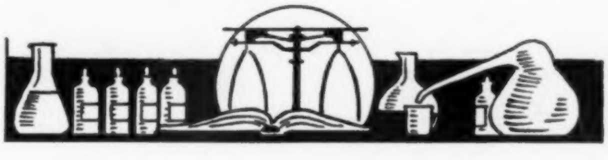

The Third Thomas Alva Edison Foundation Institute

• By Vice Admiral Harold G. Bowen
EXECUTIVE DIRECTOR, THOMAS ALVA EDISON FOUNDATION, INC., WEST ORANGE, NEW JERSEY

Here is a brief account of the important findings of the Albany meeting of the Thomas Alva Edison Foundation Institute which studied the question of how the schools and industry can best work together.

Since science teachers hold a pivotal role in bringing about a closer and more effective relationship, they will be interested in the conclusions reached by the Institute.

A cordial invitation to teachers and pupils to visit the Thomas Alva Edison Museum in West Orange, New Jersey concludes the paper.

In order for our American industrial economy—upon which our standard of living and military striking power depends—to continue to strengthen and grow, we must:

(1) Increase the quantity of scientists and engineers;

(2) Improve the quality of science teaching; and

(3) Increase the depth and breadth of understanding of the historical development of our competitive technological industrial economy.

In developing these conclusions, participants at the Third Edison Foundation Institute, held in Albany, New York, in May, 1952, were in accord that industry and the schools should work more closely together toward these goals. The pivotal role of the science teacher in our modern industrial civilization highlighted the proceedings of the Institute.

This Institute was co-sponsored by the Education Department of the State of New York and the Thomas Alva Edison Foundation. Sixty participants including representatives from the Department of Education, superintendents of schools, presidents of boards of education, and three or four key industrialists from the industrial areas of: Buffalo, Rochester, Elmira, Schenectady, and Binghamton, concluded that by publicly recognized joint committees, representatives of industry and education should arouse public support for a curriculum that places an emphasis on science and engineering that is commensurate with their importance in our technological industrial civilization. The realization of this working relationship can be achieved if industry would:

(1) Employ science and mathematics teachers and students during their summer vacations;

(2) Encourage science and mathematics teachers at the elementary, junior, and high school levels to participate in local professional engineering and scientific activities;

(3) Utilize sabbatical leaves for elementary and secondary school educators who have made meritorious contributions to the teaching of science and mathematics;

(4) Provide plant inspections for school officials, teachers, and students, as well as parents;

(5) Explain to students the possibilities of careers in engineering and science;

(6) Ascertain educators' reactions to industrial exhibits, literature, and visual aids;

(7) Support or continue to support such activities as science congresses, science fairs, Future Scientists of America, and Junior Academies of Science; and

(8) Provide or continue to provide college scholarships and awards for high school graduates in need of financial aid

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Inspiring Students to Get the Maximum Out of the Elementary Chemistry Course

• **By William S. Haldeman,** *(A.M., Harvard University)*
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This helpful article is based on an address given by Professor Haldeman in 1952 before the St. Louis University Institute for the Teaching of Chemistry. It shows concrete ways in which student interest in beginning chemistry can be stimulated. It could have been written only by a man who really knows how to teach.

To the thoughtful reader it explains in part why Professor Haldeman is widely noted as a teacher of chemistry, and why such an extraordinarily large number of his students have been inspired to make chemistry their life work.

●

Webster defines the word "inspiring" as the infusing of an animating, quickening, or exalting influence. Many avenues are open to the consecrated teacher of elementary chemistry to arouse and develop sustained student interest in the subject. Sustained interest keeps the student on one of the main avenues he must travel to get the maximum out of the course. How may the teacher aid in developing this interest? The methods differ with different teachers.

Some years ago a one year terminal course was placed in our college chemistry curriculum for liberal arts students who do not expect to major in the subject. By choice it has been the privilege of the author to teach several sections of this subject annually for the past decade. Since part of the course is related to that of the standard high school or junior college work, it may be well to draw on it for examples and methods used in trying to maintain sustained interest by the student. Relevant motion pictures and slides are used. Lecture table experiments are emphasized in addition to the two to three hour laboratory period each week. A few slides are given here as examples.

1. How may we introduce the subject of chemistry to our students on the first day of class?

   It may be well to spend some minutes in giving answers to the question—*Why study chemistry?*

   Many years ago Dr. Edwin E. Slosson gave specific reasons why chemistry is important. A few of these reasons may be noted.

2. Chemistry gives us knowledge of the elements which make up all matter. Sand . . . to stars . . .

   Chemistry teaches us about the natural laws controlling the elements. Plants . . . animals . . .

   Chemistry is the science of energy and power. Human energy . . . automobile power . . .

   Chemistry has control over life and death. Respiration, plant growth and decay . . .

   (Appropriate comments should be made and additional examples given with each slide.)

3. Chemistry may be made the science of construction or destruction. Medical, industrial products, war, . . . destruction.

   Chemistry opens avenues to the understanding and appreciation of beauty and truth. Coal . . . to coal-tar colors . . . natural laws (truth) from the apparently lifeless bulb to the beauty of the rose.

   Chemistry is a practical science. It prepares one for teaching, medicine, industrial application and research. It gives a basis for better understanding of *life* and *living*.

4. *What is Chemistry?* Linus Pauling, the famous teacher and scientist, defines chemistry as the science of substances, their structure, their properties, and the reactions that change them into other substances.

This definition expresses in simple terms the vast sweep of chemistry in the inorganic, organic and synthetic processes and products. As practical examples it includes the oxygen of the air we inhale, the water we drink, and the food we eat. It includes the reactions by which our food is digested, assimilated, and changed into blood, teeth, tissues and the various organs of the body. It explains how these normal chemical processes produce our healthy bodies, and how through these changes energy is released in the form of body heat, physical strength and mental ability.

5. Real chemistry is not *bound* between the covers of a text, but is *found* universally in the mineral, plant and animal spheres, and in the industrial processes and products. Frequent references to the applications of chemistry in daily life and living are among the best means to develop sustained interest.

6. The history of chemistry is one of the facets of the development of mankind. Examples . . .

   Ancient elements—air, earth, fire, water . . . (92 natural and 6 artificial) . . .

   Alchemist's search . . . Base metals to gold . . .

   Modern chemistry, including atomic development . . .

   Each of these topics should be developed by the teacher.

7. Chapter on water. This chapter should be among the early ones studied in the course. There are several reasons for it. (*a*) Every student knows some facts about water which can be used to introduce new and related ones. (*b*) The electrolysis of water on the lecture table with proper equipment is an effective way to interest and guide students to understand many of the specific terms used later in the course.

8. Students gather around the lecture table—observe, ask and answer questions, some assisting in certain details as hydrogen and oxygen

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Surgical Cotton . . . from Natural to Finished Product

By O. S. Plantinga, Ph.D., *(New York University)*
DIRECTOR, COTTON & GAUZE SECTION, JOHNSON & JOHNSON RESEARCH CENTER, NEW BRUNSWICK, N. J.

This is an interesting account of how cotton for medicinal and surgical uses is prepared. The processes of ginning, cleaning, bleaching, drying and carding are described. All are necessary to make the cotton ready for sterilization.

The procedure followed is probably more complex than you suspect.

Cotton, the most important of the vegetable fibers, is the purest form in which cellulose occurs in nature. It is this endowment of natural purity which gives it the properties required for surgical uses. Because the final form in which surgical cotton is used differs greatly from that of textiles, the method of processing is different in many respects from that followed in the textile industry. From the consumer's standpoint, the prime requirements of surgical cotton are uniformity of appearance and fiber length, rapid absorbency, high fluid holding capacity, and freedom from foreign materials. These requirements determine the selection of the cotton as well as the techniques used in its manufacture.

After cotton is harvested, it is ginned. The ginning operation has two purposes: First, the removal of foreign matter from the cotton, i.e. stems, leaves, boll fragments, dust, etc., and second, the separation of the cotton fibers from the seeds. The ginning operation is very effective in removing the latter, but appreciable quantities of foreign matter generally remain. This must be removed during later manufacturing operations. Cotton is first dried as it enters the gin, in order to remove any dampness picked up in the field or in storage. The drying is done in a hot air stream. Next the cotton passes through a series of rolls, covered with saw-like teeth which pull the fibers from the seeds. The loose cotton fibers are picked up in an air stream, passed through equipment designed to separate fibers from leaf and stem, and then separated from the air stream and compressed into bales weighing approximately 500 pounds.

The quality of the cotton leaving the gin, and therefore the price, depends not only on the quality of cotton entering the gin, but upon the efficiency of the gin in removing foreign matter. All ginned cotton is therefore sampled and classified by experts known as cotton classers. The chief points considered in classing cotton are fiber or staple length, content of foreign matter, and color. The classes of cotton run from the best, which is middling fair, down through good middling, middling, low middling, and ordinary, with various intermediate classifications.

Cotton, for surgical purposes, should be selected from the highest classes available; usually good middling and strict middling. The standard procedure is to have the cotton dealer submit numbered bale samples to the prospective purchaser. The latter's cotton classer selects bales which meet the manufacturer's standards. After the bales are received they are re-checked to make certain that they meet specifications for staple, foreign matter and color.

The first step in processing is to open and clean the cotton. Since cotton fibers from different bales are liable to vary in properties, some being fine, others coarse, etc., a group of bales is blended as it is fed into the opening and cleaning equipment. In this way an even blend of finished product is assured. After passing through a bale breaker, which pulls apart large, tightly compressed masses of cotton into smaller pieces, the cotton is further opened in other equipment designed to separate the fibers as much as possible. The loose cotton is carried by air through cleaners. Various devices, such as gin saws, further separate the fibers, and foreign material is removed by means of grid bars or screens. In other cases the cotton is subjected to beaters rotating at high speeds. The centrifugal force developed throws the foreign matter out through screens while fibers are borne along by an air stream.

Up to this point the processing of surgical cotton has been similar to that used in a textile mill, where the next steps would be to pick and card the cotton, prior to doubling and spinning. This is done while the cotton is still in the grey or natural state, having been neither boiled nor bleached. The reason for this is to take advantage of the lubricating properties of the natural wax which is formed on fiber surfaces during growth. This wax materially aids many of the textile operations, especially drafting and spinning. However, because of this waxy substance, grey or natural cotton is non-absorbent. Since absorbency is one of the prime requirements of surgical cotton, the next step is normally to boil it with chemicals and remove these waxes.

The cotton from the openers may be blown directly into a large steel pressure vessel known as a kier. The amount of cotton which is boiled in a kier varies with the size, but is generally in the range of one to five thousand pounds. Chemical boiling can be accomplished in numerous ways, but the following factors must be considered in the process: 1. liquid-cotton ratio, 2. chemicals used and concentration, 3. temperature of the boil, and 4. length of boil. The liquid-cotton ratio is generally fixed by the type of equipment used and chemical concentrations are generally adjusted with this factor in mind. If, for example, a low ratio of liquid to cotton is used, it is generally necessary

to increase the concentration of chemicals to secure an adequate boil. The two chemicals used in the boil solution are caustic soda and either soap or a detergent. The concentration of caustic soda used is in the range of 1-3%, and depends on the liquid-cotton ratio, the temperature, and time required for boiling. The soap or detergent must be chosen very carefully in order to effect as complete a wax removal as possible. There are many soaps and detergents which are quite ineffective in producing an absorbent cotton to meet surgical specifications, even when they are used in high concentrations. In some cases, detergents will be found which are very effective from the standpoint of making the cotton absorbent, but which will form a chemical union with the cotton. In this case, the detergent will not wash out of the cotton, but will remain as an undesirable impurity. Effective detergents are generally used in concentrations of 1% or less.

The temperature of the boil is determined by the equipment used, and the chemical concentration. In general, if the operation is carried out at the boiling point at atmospheric pressure (212° F.) a higher concentration of chemicals is necessary to give a satisfactory boil than if it is carried out under pressure, for example, at 250° F.

The time required depends again largely on the equipment used. On a laboratory scale, cotton can be boiled satisfactorily in fifteen minutes or less. However, in a large kier, holding about 5,000 pounds of cotton, the time may be as much as five hours before the boil is complete. The reason for this is that the boil liquid does not circulate uniformly through a large kier and therefore, more time is required to insure that all the cotton has been boiled.

After the boil is finished, the liquid is drained off the cotton and it is washed with water until the last traces of boil liquid have been removed. The water used in washing the cotton must be relatively free of mineral impurities, otherwise the latter become attached to the cotton as a result of ion exchange.

The cotton is next bleached. This can be done using either sodium hypochlorite or hydrogen peroxide. The choice again, will depend on the equipment available and process economics. For reasons of simplicity, we will confine our description of bleaching surgical cotton to the use of sodium hypochlorite, since this is most commonly used.

The boiled, washed cotton, may be bleached in the kier, if the latter is properly lined so as to prevent the pickup of iron. Otherwise, the cotton is transferred to wooden tubs having perforated false bottoms. Dilute bleach solution (0.1-0.2%) is then circulated through the cotton at about room temperature. Elevated temperatures should be avoided, in order to prevent breakdown of the cellulose. The cotton bleaches quite rapidly. Residues of foreign matter, such as bits of stem, leaf, etc., are acted on more slowly by the bleach solution. One important function of the bleach solution is to destroy as much of the foreign matter as possible. The length of time required for bleaching is controlled mainly by the amount of cotton being treated, and the nature of the equipment used. With large amounts of cotton, several hours may be required before the bleach solution has percolated throughout the entire mass.

After bleaching, the cotton is washed with water to remove excess bleach solution. If desired, an "antichlor" such as sulfur dioxide solution may be added to the first wash water, to insure destruction of residual bleach solution, since sodium hypochlorite, if present during the drying operation, will cause serious deterioration of the cellulose.

After bleaching, the cotton may be dried or it may first be given a "souring" treatment of dilute sulfuric acid. The latter is often necessary if undesirable mineral constituents are present which may have been picked up from processing solutions. The pH of the cotton during "souring" should be kept at 3 or above. Whether or not "souring" is used, the pH of the finished cotton should be about 6 before being dried.

The wet cotton is conveyed to the dryer by means of air blowers. Although drying practices vary, continuous type hot air dryers are generally employed. Wet cotton is separated from the conveying air by means of a rotating perforated screen, known as a condenser. Cotton from the condenser drops onto a conveyor which feeds it into a pair of heavy rolls, which squeeze out excess water. From here it is fed directly onto the conveyor of the dryer.

The cotton dryer is a long, tunnel-like shell open at both ends. A moving stainless steel conveyor carries the cotton through the dryer, while steam-heated hot air is circulated through it. The conditions of drying are such that the cotton issuing from the dryer should have a moisture content of 6-8 per cent. Large variances at this point produce handling difficulties during picking and carding.

The dried cotton is then conveyed to the pickers, whose function is to open up the matted cotton so that it can be carded. The pickers are essentially the same as those used in a textile mill, with some modifications to compensate for difference between grey and bleached cotton. A picker consists of three basic parts. The feeder section moves dried cotton into the beaters, where the slowly moving cotton is pulled apart by high speed blades. The blades may be smooth or may have a series of sharp points on the surface in order to get maximum opening effect. Closely spaced grid bars located under each beater force foreign matter into "picker drops." A double condenser, which is the third part, separates the cotton from the air stream. There may be one or more feeder-beater-condenser sections, so that the cotton, which is finally removed from the picker, is in the form of laps with the maximum amount of foreign matter removed, and opened sufficiently for carding.

The rolls or laps of picked cotton are stored in the lap room from which various lots are selected for blending during carding, in order to give maximum product quality and uniformity.

The cotton card is a machine which takes cotton fibers and orients, and forms them into a thin web. The card consists essentially of feed rolls, lickerin, main

(Continued on Page 36)

Significant Aspects of the Tides

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Here are facts about tides and the ways in which the facts have been determined that will be new to many readers. They are based on a multitude of observations made at thousands of places over many years.

The study of tides is carried on continually by the U. S. Coast & Geodetic Survey to which the writer is attached.

Captain Finnegan discusses the motions of the sea, and the theories that explain the propagation of tidal waves. He describes the various types of tides, mentions the great variation in tidal ranges, and explains how tides are predicted.

Motions of the Sea

The waters of the ocean basins and tributary bays, inlets and rivers cover nearly three quarters of the earth's surface. These waters are continuously in motion, due to various causes such as winds, temperature, barometric pressure, currents, the earth's movements, and the attraction of astronomic bodies. To the casual observer the motions of the sea may appear haphazard and hopelessly confused, but careful observations bring out patterns which are repeated in a periodic manner. Therefore, the causes of certain motions can be identified and data for prediction of such motions can be derived by relating the observed patterns to other recurring natural phenomena.

The most familiar periodic motions observed along our shores are the daily rise and fall of the sea and the accompanying horizontal flow. Both of these motions are commonly considered together and thus the expressions "ebb tide" and "flood tide" are frequently applied to either or both motions indiscriminately. But technically, the term tide is applied to the vertical motion, and the terms ebb and flood are applied to the horizontal motion or tidal current.

Causes of Tides

Tides result from the attractive forces of the moon and sun acting upon the rotating earth. The complicated manner in which the forces operate to produce the tides cannot be fully understood without mathematical formulation.

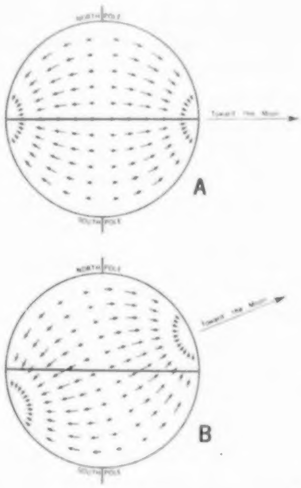
Briefly, astronomic bodies are attracted to and repelled from each other by gravitational and centrifugal forces, respectively. On one side of the earth the gravitational force exceeds the repelling centrifugal force, and on the opposite side of the earth the centrifugal force exceeds the gravitational force. The tides are a consequence of the difference of these forces acting on the earth as a whole and on the waters at its surface. The vertical components of these differential forces have a negligible effect in changing the level of the sea, but the horizontal components are effective in causing horizontal movements of the water, and thus tend to build up the water level towards points on opposite sides of the earth in line with the astronomic body concerned, and lower the water level around the earth at right angles thereto. Hence, at any given place the normal expectancy would be two tidal cycles a day as the earth rotates.

In accordance with Newton's law, gravitational attraction of an astronomic body varies directly as its mass and inversely as the square of its distance. But the tide-producing (differential) force varies directly as the mass and inversely as the cube of the distance of the tide producing body. It follows, therefore, that the mass of any celestial body, other than the moon or sun, is not sufficient to overcome its remoteness from the earth, and produce any appreciable tidal effect. Furthermore, although the moon's mass is but a fraction of the sun's mass, dividing such masses by the cubes of their respective distances—$(240{,}000 \text{ miles})^3$ and $(93{,}000{,}000 \text{ miles})^3$, the sun's force is 0.46 of the moon's force. It is because of this that the timing of the tide is identified so closely with changes in the moon's positions.

USC&GS SHIP PIONEER entering Golden Gate on its return from survey duty in Aleutian Islands. This ship carries many types of oceanographic instruments and equipment, including tide gages. The author of this article was in command of this vessel at time this picture was taken. *Photograph by V. A. Williams.*

Propagation of Tidal Waves

If there were no exposed land masses and the surface of the earth's crust were covered entirely by water of uniform depth



TIDE PRODUCING FORCES — The arrows are intended to represent the horizontal components of the differential tide producing forces over the earth's surface with respect to the moon. (A) When the moon is in the plane of the equator, the forces are equal in magnitude at points on the same parallel of latitude, but 180° apart in longitude. (B) When moon is at north (or south) declination, the forces are unequal at such points, and tend to cause an inequality in the two high and in the two low waters of a day.

the tide would maintain some uniform pattern as the moon rotated around the earth. But the irregular shapes and uneven depths of ocean basins and tributary bays, inlets, and rivers cause remarkable differences in the tidal behavior along the shores of the exposed land masses.

Until about the end of the 19th century, the popular concept was that tidal action over the waters of the earth developed entirely as a "progressive" wave. It was considered that the "generated" tide waves, one on either side of earth, progressed in an east-west direction around the earth in the broad, deep waters of the southern oceans. These waves induced secondary waves which entered the Atlantic and Pacific Oceans and moved in a northerly direction across the equator into the waters of the northern hemisphere. The secondary waves in turn generated the tide which reached into the coastal waters.

In the progressive wave the crest advances horizontally. An example of a progressive wave is that which may be observed by stretching a rope attached to a hook on the wall and agitating the rope at the free end. The motion which travels along the rope from the hand to the hook is a progressive wave. The period of a progressive wave is the time required for each successive crest to pass a given point. In the progressive tide wave the period is generally about one-half day.

One method of approach in studying the tides has been to compare the times of occurrence of tide phases, such as high or low waters at different places, where the tide has been observed. With these data a series of lines may be drawn on a map, each line indicating the places at which a certain phase of the tide occurs simultaneously. Such lines are known as "cotidal lines."

About the beginning of this century a study of the ever increasing volume of tide observations showed that the cotidal lines to be expected by the progressive wave theory did not hold true in all respects. At that time Dr. R. A. Harris of the Coast and Geodetic Survey advocated the theory that the tide in ocean basins behaved primarily in the manner of a "standing" or "stationary" wave.

The manner in which this type wave forms may be observed by use of a rectangular shaped pan or tank of water. When one end of the container is raised and quickly lowered the water moves back and forth in the form of a stationary wave. When it is high water over one half of the pan it is low water over the opposite half of the pan. Near the middle of the container there is a line where there is no rise or fall of the water. This is called the nodal line. With the limited tide observations available, Harris prepared a map of the world in which he indicated his conception of the limits of areas, within which the water oscillates as a stationary wave. Although Harris' layout of such areas and his theories still require elaboration, by later observations, the general concept of stationary wave oscillations in ocean basins has been widely accepted by tidal scientists.

However, the irregular shapes and sizes of land masses and water areas bring about such complex combinations of progressive and standing wave motions that no tidal theory has been developed by which the tidal pattern at a given place can be determined. This must be done by actual observations.

Tide Observations

Tide observations in deep ocean basins are not available. Scattered observations in some localized areas relatively close to shore in the open sea have been made, but they are insufficient for any extended study. Observations along shore in certain regions, especially in inhabited areas of maritime nations, have become quite extensive and provide a wealth of data

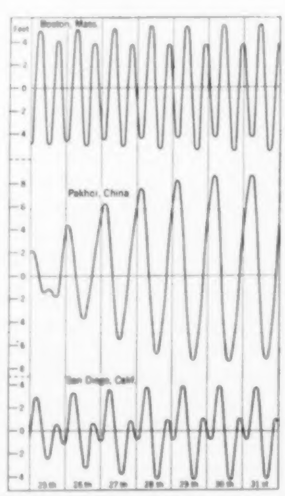


FIGURE 1. Types of Tides — Curves represent the three types of tide—SEMIDAILY at Boston, Mass.; DAILY at Pakhoi, China; MIXED at San Diego, Calif.

for the study of tides. But there are still many regions in the world where observations along shore are lacking.

Observations for the thorough study of tides at any given place are usually made with a self-registering (automatic) tide gage, which provides a continuous curve showing the height of water at any instant. Information, such as the times and heights of high and low waters and the height at each hour, serves many purposes, the principal ones being identification of type patterns, the determination of ranges, the computation of planes of reference (datum planes), and data for the prediction of tides.

Types of Tide

Bodies of water have natural periods of oscillation, which are dependent on their respective dimensions. Consequently, as they are acted upon by the tide producing forces, some respond more readily to daily or "diurnal" forces, others to semidaily or "semidiurnal" forces, and still others to a mixture of both. Therefore, tides are classified as semidiurnal, diurnal, or mixed, depending on the patterns developed by analyses of observations.

In the semidiurnal type of tide there are two high and two low waters each tidal day with relatively small differences in the heights of the morning and afternoon tides. Tides found on the Atlantic coast of the United States are representative of the semidiurnal type of tide, which is illustrated by the tide curve for Boston Harbor in Figure 1.

Where diurnal oscillations predominate, only a single high and a single low water occur each day. Tides of the diurnal type are found along the northern shore of the Gulf of Mexico, on the western shores of the Philippine Islands, and in a few other localities. In Figure 1, an example of a diurnal type of tide is given by the curve for Pakhoi, China.

The mixed type of tide occurs in a number of varieties. Here both diurnal and semidiurnal oscillations are important factors, and although two high waters and two low waters usually occur in a tidal day, there is a large inequality in the heights of consecutive high or low waters. Such tides are prevalent along the Pacific coast of the United States and in many other parts of the world.

The curve for San Diego, Calif., Figure 1, shows a mixed type of tide. Here the inequalities in the high and low waters are about the same. At some places such as Seattle, Wash., the larger inequalities are confined to the low waters, and at other places, such as Honolulu, T. H., they are confined to the high waters.

Additional examples of tide curves for a number of places may be found in the tide tables which are published annually by the Coast and Geodetic Survey. These tables, containing predictions for time and height of the tide for many ports throughout the world, will be discussed briefly under Prediction of Tides.

Tidal Ranges

The tide varies as the moon, sun, and earth change positions in relation to one another; and it also varies in many ways from one locality to another. Some of the more prominent variations are noted in the range, which is the difference in height between consecutive high and low waters.

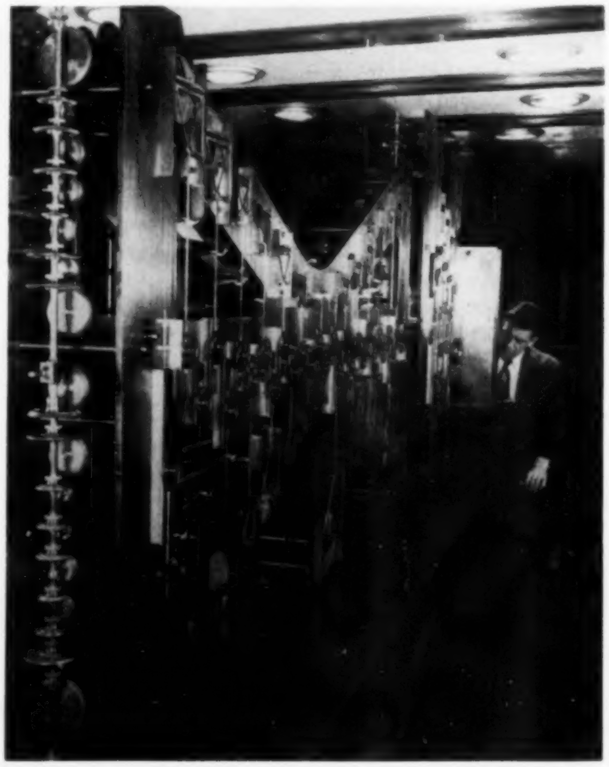
The familiar monthly phases of the moon are identified with two periods of increased range and two periods of decreased range. The increased or "spring" range occurs at new and full moon, when the sun and moon act in conjunction, and the decreased or "neap" range occurs at the time of the first and third quarters, when the sun and moon act in opposition.

There is also a period of increased range of tide during a lunar month, when the moon is in "perigee," that is, nearest to the earth, and a period of decreased range when the moon is most distant from the earth or in "apogee."

At the time of maximum north or south declination of the moon, there is a tendency for the range between one set of high and low waters of a day to become larger and between the other set to become smaller. These are called "tropic" ranges.

"Equatorial" ranges, which occur at the time of zero declination of the moon, tend to be equal throughout the tidal day.

The size, shape, and orientation of bodies of tidal waters with accompanying natural periods of free oscillations, respond in such a variety of ways to the periodic disturbing forces of the moon and sun, that most spectacular local results in range occur.



TIDE PREDICTING MACHINE showing scales and dials on which the amplitudes and epochs (harmonic constants) of various constituent curves are set.

The high tides near the upper reaches of the Bay of Fundy are common knowledge throughout the world. Here the oscillation is the standing or stationary wave type, with the nodal line near the approaches to the bay. Furthermore, the bay is of such length that its natural period of oscillation is about the same as that of the semidiurnal disturbing forces. These facts, together with the gradual slope of the bottom and the funnel shape of the bay, are noted as the cause of the unusually great ranges, up to 40 feet or more.

A very striking condition of contrasting ranges is exhibited at the ends of the Panama Canal. At Cristobal on the Atlantic side the range is about 1 foot, whereas at Balboa on the Pacific side, about 30 miles distant, the range is 12½ feet.

The Yellow and Japan Seas, which are separated by the Korean Peninsula, have tides which show very interesting variations in ranges.

On the east coast of Korea the tide ranges are less than a foot, while on the west coast large ranges occur. The largest range on the west coast is at Inch'on. Here the average range is 20.7 feet, but maximum ranges of more than 33 feet are reached when spring and perigean tides occur together twice each year. The tides here of course are an important consideration in the activities of our defense forces, especially for the vessels of the Navy. In the Japan Sea the tides are small due to the fact that this sea is well screened from the Pacific Ocean, whereas the Yellow Sea, where large tides occur, is open to the effects of oscillations in the open ocean.

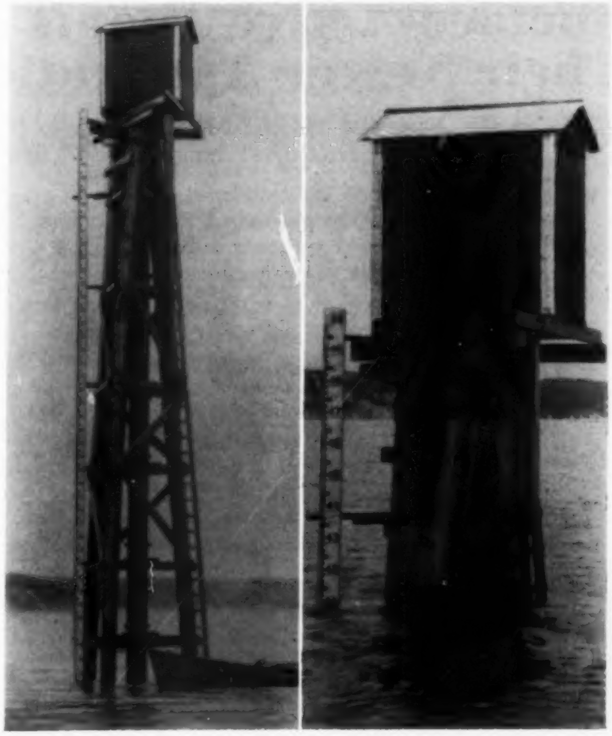
Considering the Yellow Sea itself the tides on the western shore along the China coast are smaller than the tides on the eastern shore along the Korean coast. This condition may be attributed, at least in part, to the deflection of the flow of water entering the Yellow Sea from the Pacific Ocean. This follows the principle that in the northern hemisphere a mass moving freely over the rotating earth is deflected to the right. This effect is known to many as the "Coriolis Force."

There are unlimited examples of unusual conditions of range variations and tidal patterns which could be cited but the above will serve to indicate the necessity for tidal observations to learn about the tide at any given place in the world.

Tidal Datum Planes (Reference Planes)

Reference points or planes of various sorts are essential parts of coordinated activities in our every day life. For example, we all recognize the practical value of having clocks and watches referenced to a common time zero; also of using calendars with the same initial day of reference; and likewise, of having our city streets laid out so that names and numbers are referenced to selected points or baselines, usually two principal streets intersecting about at right angles.

On a national or even world scale it is important to have two common datums, to which the horizontal and vertical locations of points may be referenced. In order that there may be sufficient points available for regional and local activities, the Coast and Geodetic Survey establishes many thousands of small brass



EXTREME RANGE of tide at Anchorage, Alaska, is emphasized by these photographs taken at low and high stages of the tide.

discs, distributed over every state of the Union. The discs are of two principal types—triangulation marks, which denote points in a horizontal control system; and bench marks which denote points in a vertical control system. The Survey carries on the necessary work to determine the precise value for each of these marks in the respective control systems.

The basic reference plane for the vertical control system is the tidal datum plane of mean sea level, which is determined through tide observations at selected points along our extended coastline.

By use of the bench marks established throughout the country, elevations on topographic maps, aeronautical charts, airport landing charts, on grades for highways, railroads, pipelines, tunnels, and on surveys for all types of engineering construction may be referred to one vertical control datum. Therefore, two surveys or projects started at any distance apart will join properly and without dispute when brought together.

Depths and elevations on nautical charts are referred to tidal datum planes. All projects on tidal waters, such as construction of wharves, bridge piers, shipyards, and surveys of waterfront property lines are directly concerned with tidal datum planes.

Prediction of Tides

The sound wave of a musical note is considered the combination of the fundamental tone and overtones which determine its quality. In like manner the tidal

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Surface-Active Agents and Their Newer Applications

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This is the concluding portion of the article on synthetic surface-active compounds begun in our December, 1952, issue. It considers the Cationic and Non-Ionic agents.

Here you will find a number of compounds that are familiar to you through daily use.

PART II

The Cationic Agents

Cationic surface-active agents are so designated because the lipophilic group which is the cation, is responsible for the surface-active properties. They are referred to as "cationic detergents" and "invert soaps." The cationic agents are almost exclusively quaternary ammonium salts. Four of the valences of the nitrogen atom are satisfied by organic radicals, and are covalent in nature. The fifth valence bond is ionic. The product is a salt-like compound and may be compared to ammonium chloride in which the four hydrogens are replaced with R groups.

NH_4Cl	$NR_4{}^+Cl^-$
Ammonium Chloride	A Quaternary Ammonium Chloride

The R groups may be the same; but when different and complex groups are substituted for the hydrogens, new and interesting properties are conferred on the compound. At least one of the R groups should be from 10 to 20 carbons in length. This acts as a tail and insures suitable lipophilic properties. The hydrophilic properties are contributed by the ionic portion of the molecule. A large number and variety of compounds of this nature are possible not only because of variations in the cation but also because of the numerous anions which may be used. The halides are the most popular, but sulfate, hydroxyl, alkoxy, and others have been tested. However, the number of commercially available products is relatively small.

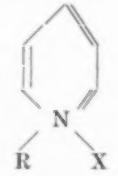
The cationic agents exhibit strong surface-active properties and possess the desirable combination of detergent action and bactericidal activity. Their uses have been mainly confined to that of germicides, sanitizers, and general disinfecting agents in such diversified applications as medicine, food industries, laundries, and the home. Their use as general detergents and as emulsifying agents has not been very promising. Lack of toxicity studies, and the fact that their cost has been high account for this in part. Nevertheless, these drawbacks have been more than offset by the many ways in which these materials can be applied. They are used at the rate of several millions of pounds a year.

Physically, these agents may be crystalline, amorphous, or waxy solids, or they may be resinous oils. They exhibit a wide range in solubility in both aqueous and non-aqueous solvents. They are colorless, odorless, and tasteless in the concentrations in which they are used. Recent reports also indicate that they are non-toxic. The cationic agents are effective in very high dilution. They remain stable after standing long periods of time, or when subjected to extremes in temperature, and even when subjected to autoclaving. Moreover, they are non-volatile and non-corrosive. These properties make the quaternaries more desirable than most other bactericidal agents.

It must be emphasized that these agents are not compatible with anionic agents, such as soaps. The anion of soap will combine with the cation of the quaternary and may form a cloudiness or a precipitate. Often this incompatibility is observed only by a reduction in the bactericidal activity. At any rate, anionic and cationic agents *should not be used together*. It is recommended also that an anti-rust agent be added to a solution of a quaternary, particularly when instruments are to be sterilized, and when material that will corrode is to be in contact with the solution for an extended period of time.

In this paper we shall discuss only the major types of quaternaries, those that are more popularly employed. Our classification is based upon the nature of the lipophilic portion of the molecule.

The first group includes the alkylpyridinium halides and their homologues. The nitrogen atom is part of a heterocyclic ring such as pyridine, picoline (a methyl pyridine), or lutidine (a dimethyl pryidine). The heterocyclic ring shares three of nitrogen's valences and the fourth is joined to a hydrocarbon residue. The cetyl group, a sixteen carbon chain, has been found to confer optimum bactericidal activity. A halogen generally utilizes the fifth bond which is ionic in nature. The general formula for the alkyl pyridinium halides is:



A popular example is cetyl pyridinium chloride which is known commercially as Ceepryn Chloride (Merrell). The R group is the cetyl residue. It is employed in minor wounds by topical application and is used for prophylactic antisepsis. It may also be applied by irrigation to accessible mucous membrane. It is marketed as a tincture (1:500) and (1:200), as a solution (1:1000), and as a concentrated solution (10%).

Ceepryn is the active ingredient of Cepacol (Merrell) which is a popular mouth wash. Quatresin (Upjohn) is myristyl gamma picolinium chloride. Fuldicide No. 10 and No. 25 (Fuld Bros.) are lauryl pyridinium chloride. Emulsol 660B (Emulsol Corp.) is also a brand of lauryl pyridinium chloride.

The second group of cationic agents contains the alkyl benzyl ammonium halides. The nitrogen is joined to a benzyl group, a long alkyl chain, and usually two methyl groups. The fifth bond is joined to a halide. The popular benzalkonium chloride is representative of this group. Chemically, it is alkyl benzyl dimethyl ammonium chloride. The alkyl portion ranges from C_8H_{17} to $C_{18}H_{37}$. The primary source material is natural vegetable oil such as palm oil or cocoanut oil. The oil is hydrolyzed and the resulting fatty acids are reduced to form the corresponding alcohols. Hydrochloric acid converts the alcohols to the chlorides. This mixture is referred to as "lorol chloride" and it contains mainly lauryl chloride. Lorol chloride is treated with methylamine and benzyl alcohol to form benzalkonium chloride. This compound is marketed under the trade name of Zephiran Chloride (Winthrop-Stearns) as a concentrated solution (12.8%), a dilute solution (1:1000), and as a tincture (1:1000). The tincture (1:1000) finds extensive use for disinfection of the skin, as a germicide, and in the treatment of minor wounds. It is well-tolerated by the skin. A dilute solution (1:2000 - 1:10,000) may be used on mucous membranes and denuded areas of the skin for preoperative disinfection. More dilute solutions (1:20,000 - 1:40,000) are recommended for bladder and urethral irrigation.

Roccal (Winthrop-Stearns) is a technical grade of benzalkonium chloride. It is used for sanitizing equipment and utensils in food plants, hospitals, restaurants, etc. It is generally employed in the strength of 200 parts per 1,000,000. Benzalkonium chloride is marketed as Alzan (Winthrop-Stearns), Rodalon (Rhodes), Triton K-12 (Rohm and Haas), and Zylium (Turco Products). Triton K-60 (Rohm and Haas) is lauryl dimethyl benzyl ammonium chloride. Cetyl Zephiran (Winthrop-Stearns) is a brand name for cetyl dimethyl benzyl ammonium chloride.

This group may also include the alkyl trimethyl ammonium salts. Cetavlon (Rhodes), Cetab (Rhodes), and Ctab (Baker) are all brand names for cetyl trimethyl ammonium bromide. Retarder L A (du Pont) is a commercial product for stearyl trimethyl ammonium bromide.

The third class of quaternary ammonium surface-active agents contains compounds having an aromatic ring in the long side chain or tail of the molecule. Benzethonium chloride and methyl benzethonium chloride are typical examples which are marketed under numerous names. The former is another chemical name for *p-t*-octylphenoxyethoxyethyl dimethyl benzyl ammonium chloride. The latter salt is the cresoxy derivative rather than the phenoxy. Benzethonium chloride is marketed as Phemerol (Parke-Davis) in the form of a tincture (1:500) and a solution (1:1000). It is used as a general antiseptic and germicide. It is also marketed under the names of Hyamine 1622 (Rohm and Haas), Bactine (Miles), Germex (Cutler), and Polymine D (Rohm and Haas). Methyl benzethonium chloride is marketed as Diaparene Chloride (Homemakers Products). It is recommended for the disinfection of babies' diapers. It is capable of destroying the bacteria responsible for causing ammonia dermatitis in infants as a result of the decomposition of urine. Methyl benzethonium chloride is also marketed as Hyamine 10 X (Rohm and Haas).

The fourth group to be discussed contains those agents which have an amide or ester linkage introduced into the long chain of the lipophile. Emulsol 607 M (Emulsol Corp.) is the myristic ester of colaminoformylmethyl pyridinium chloride. Emulsept (Emulsol Corp.) and Stirilex (Pittsburgh Chemical) are similar type commercial products. The Emulsol Corporation was the pioneer with this type product. It was found that the lauric ester was the most active and least toxic germicide in a series of compounds of this nature. The introduction of a carboxyl and amide group into the molecule has a decided effect on the germicidal properties of the compound.

The quaternary ammonium salts are now used extensively for the following applications: preoperative germicidal agents, hand disinfectants, cold sterilization of instruments, treatment of minor wounds and for various skin conditions as impetigo and ringworm, in laundries as a disinfectant, and in eating and drinking establishments for sterilization purposes and general disinfection. Many cities require the use of a solution of hypochlorite or a quaternary ammonium salt for the disinfection of eating and drinking utensils. Beauty salons and barber shops use a solution of quaternary ammonium salt to disinfect combs, brushes, razors, and scissors.

More and more, the quaternaries are finding newer therapeutic applications. In eye preparations they promote a rapid onset of action of other drugs that may be present. Zephiran chloride (1:50,000) is used to maintain and insure sterility of ophthalmic solutions for at least two weeks. Omaderm (Colin), a solution containing one-half per cent Hyamine 10X in addition to benzocaine and benzyl alcohol, is employed in the treatment of otitis media. Zephiran may also be employed for this condition. Narakon (Baybank), a preparation containing benzalkonium chloride (1:3500), is used in nasal therapy for the relief of head colds. Benzalkonium chloride (1:1000) is used as a vehicle for penicillin aerosols. Phemerol (1:1000) is found in throat preparations for the treatment of tonsilitis and pharyngitis in the form of a spray or swab. The quaternaries are popularly used today as deodorizers both for household and industrial odors. They achieve their effect without imparting an odor of their own. Hyamine 1622 in high dilution is used to combat cooking odors. As a one per cent solution it is effective for destroying body odors and for deodorizing clothes.

The Non-Ionic Surface-Active Agents

The surface-active agents in this group do not dissociate into ions. The molecule has a balanced hydrophilic-lipophilic nature due to the presence of polar and non-polar groups. The polar groups contributing

to the hydrophilic nature are usually hydroxyl groups, ester linkages, and oxyethylene groups. The non-polar groups are the long hydrocarbon chains of fatty acids and fatty alcohols. They contribute to the lipophilic character of the compound. The non-ionic agents are the newest addition to the family of surface-active agents and appear to be the most promising.

Chemically, these agents are complex esters, ether-alcohols, alcohols, or ester-ethers. They are prepared from polyhydric alcohols, ethylene oxide, fatty acids, and fatty alcohols. The properties of the final product depend upon the balance of hydrophilic and lipophilic groups in the molecule. For optimum surface activity it is essential that there be a favorable balance. A strong dominance of either lipophilic or hydrophilic groups will result in a poor surface-active agent.

These non-ionic agents possess numerous advantages over the anionic and cationic types. Since they are non-ionic, they are not affected by salts and are thus stable in hard water. They do not form insoluble soaps and are not affected by strong acids and alkalies. They are neutral in reaction and completely compatible with either anionic or cationic agents. Since they are non-ionic they are less likely to produce skin irritation.

The non-ionic agents may be classified into four main groups, but it must be emphasized that there is no sharp division between the types. There is a gradual change from agents which are strongly lipophilic to those which are strongly hydrophilic. The number of agents possible in this classification is very large and an agent may be designed with specific properties for a specific purpose.

In the first main subdivision the lipophilic nature is so dominant that the agent is completely soluble in the non-aqueous or oily phase. There is slight, if any, attraction for the water layer. Glyceryl monostearate is an example of this type.

$$C_{17}H_{35}-\underset{\underset{O}{\|}}{C}-O-CH_2-\underset{\underset{OH}{|}}{CH}-CH_2OH$$

Glyceryl Monostearate

It functions chiefly as a stabilizing agent and as a thickening agent in emulsions or as an auxiliary emulsifier. The long stearyl radical accounts for the predominance of lipophilic properties. The two hydroxyl groups and the ester linkage are ineffective in providing suitable hydrophilic properties. It is marketed as Aquaxerol (W. R. Greef). Similar type products are propylene glycol monolaurate, marketed as Crill No. 24 (Croda), and propylene glycol monostearate, marketed as Crill No. 26 (Croda).

The second subdivision contains agents which have a suitable balance between hydrophilic and lipophilic groups, the lipophilic nature being dominant. Chemically, they are partial esters of fatty acids (lauric, palmitic, stearic, and oleic) and hexitol anhydrides (hexitans and hexides) derived from sorbitol or mannitol. They are generally oil-soluble and water-dispersible. These are marketed under the brand name of Spans (Atlas Powder Co.). Span 20 is sorbitan monolaurate, Span 40 is sorbitan monopalmitate, Span 60 is sorbitan monostearate, and Span 85 is sorbitan trioleate. Arlacel (Atlas Powder Co.) is a similar type agent which utilizes mannitol as the polyhydric alcohol. Sorbitol Laurate and Sorbitol Oleate are marketed by the Glyco Products Company.

The third subgroup contains agents which are well-balanced but the hydrophilic properties predominate. These agents are readily prepared from the agents of the second subgroup. The partially esterified hexitol anhydrides have one or more hydroxyl groups which are not esterified. The hydroxyl group, although conferring hydrophilic properties to the esters, is not strong enough to dominate the strongly lipophilic hydrocarbon residue of the fatty acids and the cyclic hydrocarbon of the hexitol anhydrides. The oxyethylene group ($-O-CH_2-CH_2-$) possesses hydrophilic properties which are weaker than the hydroxyl group. However, if sufficient groups $(-O-CH_2-CH_2-)_n$ are condensed with the unesterified hydroxyl groups, then the hydrophilic nature of the entire molecule will be altered so as to produce a dominantly hydrophilic molecule. For this to be realized, n should be between 10 and 20. This type product is marketed under the trade name of Tween (Atlas Powder Co.). Tweens 20, 40, 60, 80 are polyoxyethylene ethers prepared from the Spans of the corresponding numbers. In England these products are known as Crills (Croda). A wide variety are available and they correspond in composition to the Spans and Tweens in this country.

The condensing of polyethylene glycol with fatty acids produces a series of agents that range between subgroups two and three.

$$HOCH_2(CH_2OCH_2)_nCH_2OH + RCOOH \longrightarrow$$
$$RCOOCH_2(CH_2\text{-}O\text{-}CH_2)_nCH_2OH + H_2O$$

The slight hydrophilic nature of the fatty acid is magnified by condensing the fatty acid with polyethylene glycol. The larger n is made, the greater will be the hydrophilic nature of the compound. An example of this is Polyethylene Glycol 400 Monostearate. The 400 refers to the molecular weight of the polyethylene glycol which is condensed with stearic acid; n being equal to 7-9. Commercial types are Estax 36 (Watford), polyoxyethylene oleate; Estax 31 and 39 (Watford), polyoxyethylene stearate; and a series of similar products known as Myrj (Atlas). These agents find extensive use as emulsifying agents. They may be used to produce either the oil-in-water or water-in-oil type emulsion. They are used also as thickening agents, oil solubilizers, and in the preparation of "washable" pharmaceutical preparations.

Those agents which are strongly hydrophilic comprise the fourth subdivision of non-ionic surface-active agents. Their hydrophilic nature is so strong that the agent is entirely soluble in water and shows but slight affinity for non-aqueous material.

The polyethylene glycols are found in this group. They have the general formula,

$$HOCH_2(CH_2OCH_2)_nCH_2OH$$

When n is from seven to nine, the product is known as polyethylene glycol 400. The number 400 indicates the average molecular weight of the compound. When n is seventy to eighty-five, the product is known as

(Continued on Page 37)

Mushrooms

• By **George Antonoff, D.Sc.,** *(University of Manchester)* ***and***
CONSULTING CHEMIST, NEW YORK CITY

Raymond Madrazo, Jr.
SENIOR STUDENT, QUEENS COLLEGE, FLUSHING, NEW YORK

With an ADDENDUM by Dr. A. Yakimac.

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The very considerable interest created by Dr. A. H. Smith's article on "Mushrooms, Edible and Otherwise" in our September, 1951, issue justifies a second article on the same subject.

Dr. Antonoff is known to our readers for his several Science Counselor articles, the latest, "On Assimilation of Atmospheric Moisture," in our June, 1952, number. It is concerning that article and this paper that Dr. Alexis Yakimac, Sc.D., has been kind enough to comment in an Addendum.

•

In the summer of 1946 when we took an extensive trip through New Hampshire and Vermont we discovered two things about mushrooms in that part of the United States. The first was the variety of mushrooms in New England that range from esculent to deadly poisonous. The second, and most important, was their abundance. We agreed that the abundance of mushrooms is caused by the lack of interest or the complete ignorance of the nutritional value of mushrooms by New Englanders. By this article we hope to interest and educate the reader in the usefulness of mushrooms.

Since mushrooms live in a very rich soil their nutritional value is practically equal to that of meat. In spite of this, mushrooms are not a popular food. It was only during the First World War, when there was an acute shortage of food, that articles began to be published in the United States which revealed the nutritional value of edible mushrooms. In London, when this question was discussed at a conference during World War I, the foreign delegates recommended that mushrooms be used as a food to supplement the British diet. But the British did not want to listen. Their views were expressed by one spokesman: "In the Seventeenth Century we had many cases of mushroom poisoning, and we made our people believe that they are all poisonous. Now we do not want to advise them to the contrary." Present-day English people still have an aversion to mushrooms. In Scandinavia, where mushrooms are abundant, they became recognized as a good food after the articles on mushrooms were published in the United States.

For lovers of nature, the art of collecting mushrooms is fascinating. In places where too many people walk in the woods, mushrooms gradually become extinct. Therefore, to find mushrooms growing abundantly it is necessary to get off the beaten track. In France, there are certain woods where people are warned by huge roadside placards to beware of snakes. The wood of Rambouillet, which is the summer residence of the President of the French Republic, is an example of a snake infested woods. Because of such warnings the French public does not risk walking in the wood of Rambouillet; consequently, there is an abundance of mushrooms in this region even though it lies near a thickly populated center. People who walk in these woods always wear protective leggings. If they are accompanied by a dog they take a protective serum with them because canines are particularly vulnerable to snake bites. Dogs, with their acute sense of smell, can be trained to help find mushrooms even before they come out of the ground.

The Nature of Mushrooms

Mushrooms are one of the lowest forms of life. Like everything living they are made of cells that are distinguishable only under a microscope. The Latin name for mushrooms is *fungus*, and the science that deals with mushrooms is mycology; but mycology is generally taught as a branch of botany. Fungi do not have the typical features of plants. The one typical characteristic of plants is that they contain chlorophyll, thereby making them capable of synthesising organic matter.

Plants are classified according to their method of propagation. The highest form of plant life propagates by means of flowers. The next group, the conifers, propagates by means of an incomplete flower. The lowest type, the *sporaceae*, have no flowers at all, and this type of plant life propagates by means of spores. This latter category consists of ferns, palms, mosses, algae, etc., which are considered plants because they contain chlorophyll. Fungi also propagate by means of spores, but they have no chlorophyll and, therefore, they are not classed as plants. Fungi can live on ready-made food which they obtain, as *parasites*, from a living body, or from a dead body (decaying leaves), in which case they are called *saprophytes*. In this sense mushrooms are somewhat similar to animals. However, one major difference between animals and plants is that plants are not able to perform the normal function of animals, which is to decompose products previously manufactured by plants. Fungi, although not capable of this process, are a source of many complicated chemical processes not yet properly known and understood. Thus, they are neither animals nor plants, but an independent kingdom of nature.

In nature there are the so-called *lichens* which have properties similar to fungi but with the added ability

to assimilate the carbon dioxide in the atmosphere. It has been proven that lichens are not an individual species but a *symbiosis*. (i.e., a co-habitation of fungi and sea-weeds [algae] which contain chlorophyll.) The two species live together and mutually aid each other by the products of their activities but they are not genetically connected. A typical example of lichens is the so-called Island Moss that grows on the barks of living trees and which serves as a food for reindeer in the northern countries. It always grows on the northern side of the tree and it protects the tree from cold winds. It also helps people without a compass who are walking in the woods to know the cardinal points of direction

The Genus Boletus

In the interesting article by A. H. Smith in the September, 1951, issue of *The Science Counselor* various esculent and poisonous mushrooms were described. But nothing was said about the *genus boletus* which is represented in nature by several sub-species most of which are very good for eating. The best variety is the *boletus edulis*. Its cap is brown and its flesh remains white when exposed to the atmosphere. The lower surface of the cap has no radiating plates like most of the species described in the article by Smith. The lower surface of the cap in this species is almost white in a young specimen but it becomes yellow and yellow-green as the mushroom matures*.

There is only one variety of *boletus* that is not recommended for eating. This variety has such distinctive features that it cannot be confused with the good species. This non-esculent *boletus* has a bright red stem and its flesh turns green or blue when it is cut.

In the woods where the birch tree grows one can find a similar mushroom that also has a brown cap but whose stem is covered with minute black specks. The flesh does not become colored when it comes in contact with the air. It is considered to be of a quality slightly inferior to *boletus edulis*.

Another variety of *boletus*, *boletus scaber*, has a red cap and its flesh turns dark blue upon cutting. It is delicious when it is cooked, but the blue color often scares people into thinking that it is poisonous. Its color ought to attract the attention of chemists who want to know how nature manufactures this beautiful dye.

A good specimen among the *boleti* group is the *boletus luteus*. It can be recognized by a slimy, oily skin on its cap. The lower surface of the cap is yellow in a mature specimen, but in the young it is covered by a white skin. Later, the skin remains attached to the stem.

In the vicinity of this mushroom there is often found a similar specimen. When viewed from the top, it is almost identical with *boletus luteus*, but the lower surface of the cap has radial plates indicating an entirely different species. This specimen is not an esculent one and, therefore, when collecting these mushrooms one must always look at its lower surface. With this precaution, a mistake in identification can be avoided.

In the United States all the European species of mushrooms exist, but curiously enough the abundant *boletus edulis* is, in some localities, bitter. This mushroom looks exactly like the *boletus edulis*. The only way to distinguish it from the true *boletus edulis* is to taste it when it is raw. There is practically no danger attached to the *boleti* in regard to being poisonous, but most people prefer to eat varieties of mushrooms in which the risk of being poisoned is at a minimum.

Dangerous Mushrooms

There are no general or well defined clues that distinguish a poisonous mushroom from a non-poisonous one. There is a popular belief that the poisonous mushrooms are never worm-eaten. This is justified in the case of very poisonous varieties, but it does not apply to the *amanita muscaria* whose poison is comparatively mild. The worms apparently can adjust themselves to the effects of the poison by forming an immunity against it. The poison in the *amanita muscaria* is soluble in water. It can be eliminated in two ways. One way is to boil the mushroom in water several times. The second method is to cover it with salt. While in contact with the salt the mushroom secretes a juice by an osmotic process. The juice is thrown away and the flesh is washed with hot water to remove the salt or any juice that is left in the mushroom. Washing need not be prolonged if the flesh was crushed after salting. When the water does not taste salty, the washing may cease. Some people prefer to take an extra precaution and boil the flesh, but for the most part this is superfluous. The abundance of the *amanita muscaria* is largely due to the fact that it is not as a rule picked, and it is this fact that makes it a valuable food in cases of emergency. As its name suggests, this mushroom is often used as an insecticide, especially for killing flies.

Cases of mushroom poisoning are not known in Russia, but they occur very frequently in France, where every Fall many fatalities due to mushroom poisoning are reported in the newspapers. The French are particularly fond of the *amanites* where the possibility of a mistake in identification is highly probable. On the other hand, they have a faulty conception of the *boleti*, which they often describe as poisonous.

Antonoff had many opportunities to observe an extreme ignorance of mushrooms in all the European countries that he visited. For example, in the southern part of France the people call the best species of mushrooms poisonous, contrary to the opinion of mycologists. During a trip to the southern part of France, Antonoff once stayed at a country hotel in the Pyrenees. While there he collected many types of edible mushrooms. They grew abundantly throughout the vicinity because nobody collected them. One of the common ones was the red-topped *boletus scaber*. He brought some of them back to the hotel to eat, but the hotel management flatly refused to cook them. To support their argument they showed him a French dictionary called *Le Petit*

* There is a variety of *boletus* that has all the distinctive features of the *boletus edulis*, except that it parasites upon the bark of living trees. The flesh of this mushroom has a wood-like hardness, and for this reason it is not suitable for eating.

Larousse which contained a description and a picture of some mushrooms. In this dictionary the *boletus scaber* is placed under the wrong heading, being marked as a poisonous mushroom. Antonoff had to cook these mushrooms himself. He ate a copious portion of them in the presence of the management and to their great surprise he remained in perfect health.

The French are also very fond of one mushroom with a shiny red cap which is different from the *amanita muscaria* in that it has no white spots on its cap. Occasionally the *amanita muscaria* grows without spots, in which case a mistake in identification can easily be made. The French are fond of the *amanites*, but the edible species is almost undistinguishable from the deadly poisonous one which, according to their belief, decomposes the blood. Once while Antonoff was walking in the woods about fifty miles from Paris he met a connoisseur of mushrooms who taught him how to distinguish the poisonous variety of *amanites* from the non-poisonous ones. Soon they met two other men who were collecting *amanites*. Both of them had collected the poisonous variety. When Antonoff's companion saw that they had picked poisonous *amanites* he shouted, "What are you doing? If you do not throw them away you will die in agony."

On the Cultivation of Mushrooms

The problem of cultivating mushrooms is not a simple one, and so far its only success has been with the edible mushroom. The cultivation of mushrooms created an industry that suffered a set-back with the coming of the automobile because mushrooms need a very rich soil that is fertilized by large amounts of horse manure. It has been suggested that this industry can be revived again if a cheap, synthetic hippuric acid, which is contained in horses' urine, can be developed. All attempts to cultivate or even to transplant the *boletus* mushrooms have failed. Antonoff tried to transplant them with a considerable amount of their substrate, but his efforts were in vain. The moment a mushroom is detached from its native soil it begins to die. It soon becomes infested with worms. Apparently its vital processes are able to counteract the worms' activity.

In textbooks of mycology, mushrooms are defined as saprophytes. This definition apparently is not altogether correct. Perhaps the following paragraph may clarify the problem.

The study of mushrooms has always been popular in Russia because its people, throughout a thousand years of history, have suffered from famines. Consequently, they have studied every source of nourishment that can be found in the woods and fields. The Russian names for the different types of mushrooms are imaginative. They are named according to the tree under which they predominantly grow. Thus, one of the brown capped *boleti* is called the "underbirch" mushroom and the red capped *boletus scaber* is named the "underaspen" mushroom. The rule is not strictly followed. For example, the *boletus edulis* usually grows under a coniferous tree, but it will also grow under an oak tree.

After the World War I, Antonoff received the following information from Scandinavia, but he has had no way of confirming it. The Scandinavians claim that the mushrooms of the *boletus* family send imperceptible vessels into the ground that attach themselves to the roots of the tree and thereby derive additional nourishment from it, thus, these mushrooms appear to be saprophytes and parasites simultaneously. If this theory is correct it justifies the popular Russian names for the different species. It also explains why mushrooms die after they are removed from their native soil, and why their cultivation is very difficult.

Mushrooms As a Food

Mushrooms of the *boletus* type are generally cooked or broiled. Occasionally they are boiled in water or, if they are not eaten almost immediately after collection, they can be dried or pickled. In these forms they can be preserved indefinitely, but before they are eaten they must be soaked in water, after which they can be handled as fresh mushrooms.

There are numerous varieties, among mushrooms with radiating plates, that are well suited for salting. The flesh of such salted mushrooms becomes soft as soon as it secretes its juice. This juice is full of colloidal matter which would present an interesting field of study to a colloidal chemist. In poisonous varieties the juice must be discarded, but in the non-poisonous types it is a very palatable, viscous fluid in which mushrooms can be preserved. To prevent contact with air the mushrooms' juice when it is used as a preservative, is covered with a thin layer of edible oil. To preserve the mushroom for a long time the concentration of salt must be very high.

One cannot trust completely the descriptions of mushrooms given in the various books and journals because the pictures given cannot show clearly enough the differences between the esculent and poisonous varieties. This knowledge can be acquired best from someone who knows the subject of mushrooms very well. ●

ADDENDUM -- *The Role of Radiations in Various Natural Phenomena*

● **By Alexis Yakimac, Sc.D.**
MIAMI, FLORIDA

Dr. Yakimac is well known as the former collaborator of the late Madame Curie, who entrusted him first with the production of Polonium, and then with the French Radium Industry in Gif, which he conducted until World War II brought him to these shores. Before he emigrated to the U. S. A., he held a post of Professor of Physical Chemistry at University of Antioquia, in Medellin, Columbia.

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I have read with interest the article "On Assimilation of Atmospheric Moisture" by Antonoff in the June, 1952, issue of this journal, about the assimilation of moisture. He has showed me the manuscript on Mush-

(Continued on Page 37)

NEW BOOKS

Theory of Electric Polarization

• *By* C. J. F. BÖTTCHER. Houston, Texas: Elsevier Press. 1952. Pp. XIII + 492. \$10.00.

In this book the author treats the extensive field of electric polarization in a compact manner according to classical theory and gives an adequate and systematic account of the whole. The application of quantum mechanics to the theory of dielectrics may be regarded as one of the great achievements of quantum mechanics. However, the accomplishments of classical mechanics in this field must not be overlooked; its results are in the main repeated by quantum mechanics. It is for this reason that the author surveyed the fundamental concepts of this subject in the classical manner.

The author assumes the reader is acquainted with the fundamentals of electrostatics and of vector analysis. The contents are divided into eleven chapters which deal with ideal and non-ideal dipoles, concepts and problems of electrostatics, reaction field of a dipole, electric multipoles, polarization and energy, polar dielectrics at low frequencies, non-polar dielectrics at low frequencies, polarization at optical frequencies, determination of permanent dipole moments, polarization at high frequencies, and polarization of solids. Four appendices on mathematical subjects are also included. The chapter on the determination of permanent dipole moment discusses thoroughly its importance for the investigation of molecular structure and will probably be of special interest to chemists. Throughout the book, emphasis has been laid upon the connection between theory and experiment.

Since this book is well written and does cover excellently the field of electric polarization, it will probably be used widely as an intermediate text and as a reference book.

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Duquesne University

General Chemistry

(Sixth Edition)

• *By* HORACE G. DEMING. New York: John Wiley and Sons, Inc. 1952. Pp. XII + 656. \$5.75.

The sixth edition of Professor Deming's well-known text retains the same treatment of concepts which has characterized his previous editions. Some improvements have been made to conform with recent trends in chemical instruction. An interesting feature of this edition is the arrangement of the table of contents which makes it possible to change the order of presentation of topics to suit the needs of many diverse groups of students. Chapter summaries, an increased number of study questions and new illustrations will also help considerably the beginner's understanding.

A discrepancy carried over from the earlier edition appears in the discussion of acids and bases. On page 243, the author mentions that in solutions of strong acids, the H^+ exists as an oxonium ion, H_3O^+. He uses this formula intermittently with H^+ in the later discussions. It is, of course, well known that the existence of unsolvated hydrogen ions in aqueous solution is highly unlikely. Liquid water possesses very large molecular structures because of hydrogen bonding and the hydrogen ion or hydroxide ion in water becomes a part of these hydrogen-bonded complexes. For that reason a simple formula like H_3O^+ oversimplifies the situation and adds no special element of correctness. Also, the occasional inclusion of H_3O^+ in equations for reactions in aqueous solutions may cause confusion to beginning students. It would be better to recognize the existence of solvation and then write the ion as unsolvated.

Based on more than thirty years of teaching experience in general chemistry, Professor Deming's book should prove to be a satisfactory text to both the student and the teacher.

Ting Li Chu

Introduction to Modern Chemistry

• *By* P. C. GAINES, LAURENCE O. BINDER, JR. and RAY WOODRIFF, all of Montana State College. St. Louis: C. V. Mosby Co. 1951. Pp. 576. \$4.75.

This text represents a satisfactory presentation of the material normally included in the first-year chemistry course. The inclusion of "modern" in the title is, however, not particularly appropriate, since the subject matter is very largely that of conventional chemistry courses.

It is true that there is a fine chapter on nuclear chemistry (perhaps the best chapter in the book), but it is put at the very end, almost as an afterthought, and is not in any definite way integrated with the preceding material. It is true, also, that there are brief references to mass spectographs, hydrogen bonding, and other modern types of equipment and concepts, but to balance these there are numerous "unmodern" statements and concepts. For example, "molecules" of NaCl are mentioned on page 65; on page 190 the ionization of NaCl when it is placed in water is referred to (though on pages 60 and 145 the ionic nature of solid NaCl is correctly presented); on page 256

shared-electron bonds are indicated between Na and O in $Na_2S_2O_3$. Most of the equations in the book are presented in "molecular" form and the half-cell or ion-electron method of balancing equations for redox reactions is not even mentioned. This failure to develop consistently the role of ions in chemical reactions is, in this reviewer's opinion, the weakest point of the book. The discrepancies and changes of viewpoint are probably inevitable concomitants of joint authorship.

But if the text is accepted as a conventional presentation, it has a number of good features. Chapter 2 on mathematical procedures and Appendix I on the unit-factor method of making direct-proportion calculations will be a great help to the current crop of mathematically-weak students. Also the use of the special term "ato" (seen here for the first time) to designate the gram-atomic weight is a step in the direction of eliminating the confusion that commonly accompanies the introduction of this concept, though one wonders why the more inclusive term "avogram," which has already obtained some degree of acceptance, was not used instead. Numerous numerical problems, with answers, are included.

For the discussion of their descriptive chemistry the metals are grouped according to the scheme of qualitative analysis, rather than rigorously according to the periodic table. This is no doubt a boon to the student who is concurrently struggling with laboratory work in qualitative analysis, but the overall advantage might be questioned.

The book is clearly printed on high-quality paper so that, despite its considerable length, it is of a very convenient size to handle. The binding is as sturdy and attractive as one could hope to find.

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Department of Chemistry
University of Pittsburgh

Inorganic Chemistry

• *By* THERALD MOELLER. New York: John Wiley and Sons, Inc. 1952. Pp. x + 966. $10.00.

This book is divided into two parts. Part I (10 chapters, 369 pp.) deals with the basic principles required for a comprehensive understanding of inorgnic chemistry. The application of modern developments of physics to inorganic chemistry is discussed in a clear, non-mathematical manner which constitutes an important feature of this book. This part is mainly concerned with atomic nuclei and radioactivity, atomic and molecular structure, crystal structure, complex ions and coordination compounds, thermodynamic considerations as applied to chemical reactions, acid-base phenomena, and solution chemistry of non-aqueous solvents.

Part II (11 chapters, 541 pp.) is devoted to the systematic discussion of the chemical elements and their compounds. The descriptive matter, though not encyclopedic in nature, is very adequate. Many of the principles discussed in Part I are applied here. Numerous up to date references are given in each chapter. The author and subject indices are quite complete. However, one could wish for some study questions after each chapter.

This book is well organized and well written to satisfy the needs of a text for senior or graduate instruction. It gives advanced students a feeling for current researches and an idea of what may be expected in the future. It may also help industrial chemists to solve many of their problems. The author has performed a great service in writing this systematic, comprehensive and thoroughly modern text.

Ting Li Chu

Encyclopedia of Surface-Active Agents

• *By* J. P. SISLEY and P. J. WOOD. New York: Chemical Publishing Co., Inc. 1952. Pp. IV + 540. $15.00.

This book, which presents a systematic classification and a compilation of data on the major commercially available surface-active agents, is intended for use by chemists, manufacturers, salesmen, students, and others. The original, written in French by J. P. Sisley, was translated and revised by P. J. Wood, technical director of the Royce Chemical Company.

The first 30 pages are devoted to general information of non-technical nature, dealing mainly with history, properties, and applications. Then follows a unique and useful classification which identifies the modern surface-active agents by symbols. The agents are classified chemically as anionic active, cationic active, or non-ionic compounds. The major classes are divided into subclasses. A discussion of each subclass considers methods of preparation, applications, literature references, and other pertinent information.

The material concerning cationic and non-ionic agents is rather brief. An abundance of work with these agents has been reported recently. A considerable number of errors were noted throughout this section of the book. No distinction is made between "sulfonated" and "sulfated" products. Structural formulas and equations need revision. Several errors are found on page 65. Aerosol OT is not the normal octyl ester, as shown, but the ester of 2-ethyl hexanol-l. Asymmetric diethylene diamine is not the name for the compound shown on page 96. The structure for sodium heptadecyl benzimidazol sulfonate on page 69 is incorrect.

The last section of the book contains an alphabetical listing of the major agents, foreign and domestic, industrial and consumer. With each is included such important information as chemical composition, properties, reactions, applications, brand names, etc. Unfortunately a supplement to this listing was necessary. The user must consult two tables when seeking information concerning a particular product.

This book is of definite practical value and should prove useful in the fields for which it is intended. It is recommended for addition to the scientific library. The second printing, however, should have more careful proofreading. The price is high.

Martin I. Blake, Ph.D.
Department of Pharmaceutical Chemistry
Duquesne University

Handbook of Chemistry

(Eighth Edition)

• *By* NORBERT ADOLPH LANGE. Sandusky, Ohio: Handbook Publishers, Inc. 1952. Pp. 1998. $7.00.

This handbook is a valuable aid to chemists, physicists, and workers in related fields who require a ready source of up-to-date data. Probably no other book of this nature offers such a complete compilation of significant information in such a limited space.

As a result of the development of newer scientific techniques and of refinements in older ones, new and more accurate data have accumulated in the literature. This book reports them. An example is the complete revision of the table of atomic weights. The seventh edition was complete only to 1941. The present edition, however, has been extended to 1951, a ten year advance. The elements berkelium, californium, and curium have been included. Many tables throughout the book have been revised and extended. New tables have been added, a few deleted. In general, the book appears to

(Continued on Page 38)

Wonder

The grace and poise of nymph are in your flight,
O butterfly that scorns the dark of night.

Yet you are dream of moonlight and of song
Whose lyric sweetness lingers all night long.

So dance your way in sunlight spilled afar,
A connoisseur of magic that you are.

Oh, float through autumn meadow's molten gold,
For greater gift I own than you can hold:

You cannot know Whose beauty creatures sing,
Who spun dawn's poignant prism in your wing!

SISTER M. ANSELMA, C.S.C.
ST. CATHERINE HIGH SCHOOL
VENTURA, CALIFORNIA

Edison Foundation Institute

(Continued from Page 12)

who show promise of leadership in engineering and science.

Schools should do their part by:

(1) Constantly emphasizing the critical importance of the development of correct work habits in students, and the appreciation and acceptance of the idea that long and hard work is the principal ingredient of success in anything, and science and engineering are no exception;

(2) Utilizing representatives of industry for supplementary instruction in appropriate phases of economics, engineering, and science;

(3) Providing opportunities for joint discussion with representatives of industry on problems of mutual interest; and

(4) Supplementing customary instruction in science and mathematics by introducing practical problems suggested by industry.

The participants agreed that there is confusion in the minds of students as to what constitutes democracy; that the lack of understanding of its fundamentals and the consequent failure to abide by them are jeopardizing our national existence. Education in the elementary and secondary schools should be aimed at creating a satisfactory understanding, in this critical stage of world history, of the superior values of our competitive industrial economy, and of its vital contributions to our success, our progress, and our safety. It was agreed that it is democratic to encourage and give special help to superior students in all subjects because it is from this group that we must expect to derive our future leaders, and the distinguishing mark, in fact the essence of a democracy, should be the facility with which leadership can be developed irrespective of social or other origins.

If the United States is to continue as the leader of western civilization, the Institute participants urged that science teachers be provided with the necessary opportunities which will permit individual instruction and development of students of leadership caliber in science and engineering. The cornerstone of American success is American industry. Scientists and engineers are the fuel of industry.

Copies of the full report of the Institute may be obtained free of charge by sending a request to Vice Admiral Harold G. Bowen, Executive Director, Thomas Alva Edison Foundation, Main Street, West Orange, New Jersey.

Thomas Alva Edison Museum
West Orange, New Jersey

Thomas Alva Edison has been called the "architect of American industry." Most of his major contributions to society were made within the boundaries of

New Jersey. The Foundation which carries his name wishes to continue this tradition. During the past year we have endeavored to bring to the attention of educators and the public the opportunities which the Edison Museum provides in developing an understanding of the central role engineers and scientists play in a constantly expanding industrialized economy.

Tours of the Edison Museum by school and adult groups were very favorably received during the past year. Not only are visitors able to see the laboratory and library of Thomas Edison and examine many of his original inventions but, through an interpretative talk, the Museum staff endeavors to outline the contributions which Edison's inventions and discoveries have made to the creation of modern industries such as the light and power, sound recording and reproducing, motion picture, and electronics (Edison Effect) industries. Included in the presentation is a discussion of the contemporary industrial research laboratory as a basis of our military strength and standard of living and the pressing national need, for many years to come, of increased numbers of qualified engineers and scientists.

As evidence of the growth and importance of the engineering profession in industrial America is the fact that during the last sixty years the number of engineers has increased from 25,000 to 450,000. It is predicted that for our national survival, strength, and growth, there will be a corresponding rate of increase in the future. The supply must come from qualified students in schools today whose interest in mathematics and science is encouraged and who develop the work habits of questioning, studying, working and producing which were so much a part of the inspiration of Thomas Edison.

We would be pleased to schedule your group for visits to this historic shrine. The Edison Museum is open every day except Mondays and Tuesdays. Guided tours of approximately one and one-half hours' duration are conducted with no admission being charged for organized groups who have made arrangements in advance for their visit. Arrangements to visit the Museum may be made by writing or telephoning the Foundation office. ●

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Significant Aspects of Tides

(Continued from Page 19)

wave, represented by the tide curve, may be considered the summation of many constituent waves, which determine the pattern of the tide.

By a procedure known as harmonic analysis the observed tide curve is separated into numerous constituent curves, for each of which the amplitude and epoch or harmonic constants are derived. The periods of the constituent curves to be abstracted from the observed curve are those pertaining to recurring positions of the moon and sun, with relation to the earth. Selection

of such periods is not dependent on observations, but is determined by astronomic considerations.

In practice, the number of harmonic constituents used by the Coast and Geodetic Survey in predictions for its tide tables, seldom exceeds 30 for any one station.

The harmonic constants, which are determined from an observed curve, may be used to predict tides by adjusting the constants to astronomic conditions for the year and period desired. Computations for predictions may be done manually, but in the present day the work is accomplished by specially designed machines.

The tide predicting machine now in use by the Coast and Geodetic Survey was designed and constructed within the Bureau. This machine has facilities for using 37 harmonic constituents. The previous machine, retired about 1910, had facilities for using 19 constituents.

Tide Tables

The Tide Tables, published by the Coast and Geodetic Survey are designed primarily for the use of our commercial and military shipping activities. Daily predictions of the times of high and low waters for about 184 ports are printed in four volumes, covering the world. These tables also include nearly 5000 additional places, for which predictions can be made by the use of differences and ratios, applied as directed to the daily predictions listed for one of the reference ports.

Tide Tables, which cover a full calendar year, are prepared and printed so that they are ready for issue about six months before the first of the pertinent year. All predictions are completed and manuscripts actually ready for the printer about one full year in advance of the year for which they are made.

The predictions contained in the Coast and Geodetic Survey Tide Tables are the source of all such data published in our newspapers, calendars, fishing guides, and almanacs. Therefore, for every person who gets information about the daily tide from the official tables, there are many thousands who obtain their information from one of the above mentioned sources.

Conclusion

Tidal currents accompany the tide, but the timing and patterns are not related to the tide in the same manner at all places. As with the tide, current observations are analyzed, and predictions made and published for use in navigation and engineering activities on tidal waters. However the limited scope of this article does not permit inclusion of a discussion of the various aspects of tidal currents.

It may be of interest to note also that systematic observations, obtained at our basic control tide stations, are providing data for the determination of the changes taking place in the mean level of the sea with relation to the land. There are changes occurring. For example, on the Atlantic coast of the United States there has been a slow but continuous rise in the level of the sea (or sinking of the land) which has totaled about one-half foot over the past 40 years. ●

Inspiring Students

(Continued from Page 13)

are tested individually, mixture of hydrogen and oxygen plus lighted splint, result. Volume relationship, energy . . .

Students list terms and processes: physical states—gas, liquid, solid, elements, compound, physical change, chemical change, electrolysis, decomposition, combination, combustion, kindling temperature . . .

9. Importance of pure water in the home . . . Where do you get your water supply? How? . . .

   Some sources and methods of purification of water supplies for cities. New York City, Chicago, St. Louis, San Francisco, Los Angeles . . .

10. Symbols, formulas, reactions, theories, laws, numerical problems, nomenclature, atomic structure . . . must not be neglected. Experience has shown that these important factors are mastered more readily if sustained interest in the course can be maintained. Outlining and integrating the main parts of chapters before requesting recitations and reports aid in keeping up interest. However, an outline or treatise on chemistry serves merely as a guide. The creating and sustaining of interest in the subject rests largely on the enthusiasm and vitalizing ability of the teacher.

The Atmosphere. The air or atmosphere is another chapter which should receive attention early in the course. In introducing this subject one may state that we live and work at the bottom of an ocean of air or mixture of gases—the atmosphere. The significance of the statement can now be made clear by breaking up the word atmosphere into *sphere* and *atmo(s)*; the former referring to our earth as a *sphere* and *atmos* meaning gas or vapor. This or similar introduction seldom fails in creating interest in the subject of the atmosphere.

Before assigning a recitation or a quiz on a chapter it is an advantage to give a brief outline, with pertinent remarks, so as to call attention to the main topics and their integration. In practice the blackboard outline for the subject of the atmosphere may be similar to the following.

a. Ancient knowledge—air, earth, fire and water considered as elements.

b. The alchemists—their efforts and contributions.

c. 1. More recent knowledge—discovery of nitrogen and oxygen, 1772, 1774, by whom? Uses for each.

   2. Rare gases—discovery, 1895-1898, names and use.

d. Main essential components: Nitrogen, oxygen, carbon dioxide, water vapor. Use for each.

e. Other components present: dust, bacteria . . .

f. Factors tending to increase carbon dioxide in the air. Respiration, combustion, . . . Factors tending to decrease carbon dioxide — use by plants, weathering of rocks . . .

g. Liquid air, conditions for its preparation, uses.

h. Air is a mixture, not a compound—give reasons for answer.

i. Miscellaneous uses of the atmosphere. In compressed form it inflates our tires, provides the

> air brakes for trains and other transportation units, and furnishes the driving power for drills in mining. The air furnishes the oxygen essential for respiration, for the oxidation of our food with attendant heat and other body energy; it provides the abundant oxygen necessary to burn our coal, oil and gas not only in the home, but in steam and diesel engines and in millions of automobiles and trucks.
>
> The atmosphere is useful in other ways; it carries our airplanes over mountains and valleys, over lakes and oceans; it transmits the sound of our voice to our listeners; it brings to our homes the music of great symphonies, and through the mechanism of television the air transmits not only sound, but pictures of people and their activities.

After this brief outline the student will have a picture and some ideas of the chapter and its related parts. At this point a definite assignment may be made for the next class meeting.

Interest can be aroused and sustained in many succeeding chapters by giving a brief blackboard outline and commenting on same before expecting a recitation from students. For example, the chapter on aluminum becomes most interesting to students when the assignment is preceded by a brief but well organized story about Charles M. Hall. This may include his discovery of the successful method for the isolation of aluminum and the tremendous industry based on it today. As a result of his discovery the price of aluminum dropped from five hundred and forty-five dollars a pound in 1852 to fourteen cents in 1942. Today articles of aluminum are found in most of the homes in our land. These stand as monuments to him who thought the unthinkable and did the impossible. ●

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Active Nitrogen

(Continued from Page 8)

Lewis-Rayleigh afterglow which can be explained if the active substance is assumed to be N_2^+ ions, and the shortlived Kaplan afterglow which contains in addition to N_2^+ ions, normal and excited nitrogen atoms. The nitrogen atoms would not account for the long afterglow since they have a very short life.

Another possible view is the existence of molecules in the metastable state. These excited molecules can continue to exist for some time after leaving the discharge tube when they slowly revert into normal molecules with the emission of light.

The three-body collision hypothesis furnishes another explanation of the afterglow phenomenon. It can be seen that free atoms cannot combine unless they suffer collision with a third molecule which can remove the excess energy; otherwise they would fall apart again.

If the third body is the glass wall or pieces of metal, the heat is transferred to these molecules. If the walls have been decatalyzed, so that combination cannot take place at this point, then gas molecules must be present in order to remove the energy liberated on recombination of the atoms. In this latter instance the molecules are raised to an excited state, and they in turn will radiate energy by reverting to the normal molecule.

The extreme activity of active nitrogen has led some investigators to the conclusion that active nitrogen is triatomic, analogous to ozone.

A plausible interpretation of the afterglow is a combination of theories, that is, the existence of two species of active particles, one being effective in producing the luminous phenomena, the other being responsible for the chemical activity. This theory is supported by the fact that the afterglow is destroyed by heat, whereas the chemical activity still remains.

The quantum theory is supported by those experiments in which it was shown that certain gases, principally hydrogen and the rare gases, have no effect on the afterglow. The explanation for this is that the lowest energy levels of these gases are greater than the energy emitted by the active nitrogen. Helium, for example, has no effect on the afterglow, which shows that no energy has been transferred to this atom. This is understood from a consideration of the fact that the lowest excitation potential of helium is 19.7 electron volts, which is considerably higher than the energy of active nitrogen which is of the order of about 10 electron volts, if the atomic theory is accepted.

It is very evident that the problem of active nitrogen and nitrogen afterglow is not a solved one. The conflicting ideas give evidence of the complexity of reactions which are possible in discharge tubes. In all probability the phenomenon involves several mechanisms which depend on the type of discharge, the purity of the gas, and the conditions and size of the discharge tube. ●

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Surgical Cotton . . .

(Continued from Page 15)

cylinder and doffer. The cotton from the picker lap passes slowly through the feed roll. The rate of feed will depend on number of cards available and quality of carded web, but will generally be in the range of 10-25 pounds/hour/card. The lickerin roll, covered with a sawtooth type material, rotates at relatively high speed, pulling the fibers into a thin layer. Mote knives, located under the lickerin roll, separate any trash which falls out at this point. The fibers are then picked up by the main card cylinder, which travels at a higher rate of peripheral speed than the lickerin roll. This cylinder is covered with a special wire cloth in which all wires are precision ground to the same length and inclined at the same angle. The fibers carried by the card cylinder are combed against a series of narrow flat plates holding the card wires. This action parallels the long fibers and removes the shorter ones as well as foreign matter which is then removed from the flats by a stripper roll.

After passing the flats, the fiber ends protruding from the card wire come into contact with the doffer roll. The doffer rotates more slowly than the card cylinder and its teeth are pitched so as to pick up fibers from the card cylinder. Its surface speed is about $\frac{1}{30}$th that of the card cylinder, and a buildup of fibers, known as the card web, occurs in the doffer teeth. A vibrating comb strips this web from the doffer. Fine fibers and foreign matter remaining on the cylinder are thrown by centrifugal force against a screen under the cylinder and drop out as waste.

In order to prepare surgical cotton in the form it reaches the consumer, many webs from single cards are laid on one another to form a bat. As many as twenty or more cards may be set up in line and the webs combined to form this arrangement. If necessary, the bat may be folded lengthwise to the desired thickness and density required for the consumer package. The bat comes off the card lines in a continuous form, and must be cut to the proper length for final packaging. The weight of the bat per unit length is closely controlled by the rate at which the cotton is carded. In this way, it is possible to cut the cotton bat in fixed lengths to secure the proper weight for the final package.

The operation of cutting the cotton to length, and rolling it in a sheet of interleaving paper is called battering. The cotton, after being cut to length, is placed on a sheet of paper which is then folded around the cotton so that when the bat is rolled up none of the cotton will be exposed. This affords maximum protection to the product when used by the consumer. The rolled cotton is then placed in the final carton and sterilized. The wrapping of the cotton with interleaving paper plus the package in which the roll is put, form an effective means of keeping the cotton sterile until the package is opened.

It cannot be over emphasized that all manufacturing operations, in the production of surgical cotton, are rigidly controlled and designed to give the highest quality of product. The emphasis on quality starts with the selection of raw cotton. Extreme care is used at all times to prevent contamination of the cotton by any foreign matter. In addition, surgical cotton must meet all the standards set up in the U. S. Pharmacopeial Convention with regard to fiber length, absorbency, impurities, and sterility. The result is a uniformly pure product upon which the consumer can depend for surgical uses. ●

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"Let the child of low intelligence and weak natural endowments be represented by a pint container, and the child of extremely high endowments and intelligence, by a gallon container. According to the democratic concept of education, you must put into the pint container whatever kind of liquid you put into the gallon container, even though only one pint can go here and a gallon there. It will not do to put cream into the gallon container and, say, water—dirty water, at that—into the pint container. Vocational education is the dirty water we are now pouring into our pint containers. Liberal education is the cream we are giving the few." —MORTIMER J. ADLER

Surface-Active Agents

(Continued from Page 22)

polyethylene glycol 4000. Here again, the 4000 indicates the average molecular weight of the compound. These compounds of variable average molecular weight are commercially available. They find extensive use as stabilizers for emulsions that already contain a primary emulsifying agent. They increase the viscosity of the aqueous phase. The polyethylene glycols of high molecular weight are known commercially as Carbowaxes (Carbide and Carbon Chemicals).

The main application of the non-ionic agents has been in the manufacture of pharmaceutical and dermatological preparations. The strong lipophilic agents find use mainly as stabilizers and thickening agents in emulsions. They are also incorporated into ointments for valuable emollient effects on the skin. Glyceryl monostearate is finding wide use in food emulsions and in the baking industry.

The Spans are active water-in-oil emulsifiers. Although lipophilic in nature, their formula is well-balanced for the preparation of water-in-oil emulsions. They find use in ointment manufacturing, for emulsification in ice cream, bread, salad dressings, confections, etc. Spans also are effective anti-foam agents in food processing.

The Tweens are efficient oil-in-water emulsifiers. They are hydrophilic in nature but well-balanced to produce satisfactory oil-in-water emulsions. They are effective in the dispersion of oils such as flavors, vitamins, etc. Oil-soluble vitamins may be dispersed to form clear aqueous solutions. Other uses include ice cream emulsification, flavor dispersion in the baking industry, dispersion of vitamins in milk, and in the making of salad dressings.

The polyethylene glycols are predominantly hydrophilic in nature. Although they are poor emulsifiers, the low molecular weight compounds serve as stabilizers and bodying agents for emulsions. Those of higher molecular weight are extensively used as ointment bases of the "washable" type. Preparations made from these bases are readily removed from the body by washing with water. Another advantage is that they do not support mold growth. ●

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Mushrooms

(Continued from Page 25)

rooms by him and R. Madrazo, Jr., and asked for comment.

Antonoff made some experiments in the past when he worked in the laboratory of the late Lord Rutherford in Manchester, which indicated that the radiation emitted by living organisms is often accompanied by ionization.

Some years ago, while working with Mme. Curie, independently I made a similar observation: green plants produce ionization of the air, the causes of which may be two-fold: (1) they emit corpuscular matter recognizable by smell, which may act as a nucleus of condensation in the same way as the soot behaves in big cities; (2) the green light is by no means monochromatic and at least in some cases it is accompanied by short wave radiation capable of ionizing the air.

Referring to the first paper mentioned, one must admit that the change of climate due to aforestation is not due to the increase of the moisture content alone, but to the creation of nuclei of condensation, without which even in a supersaturated atmosphere there will be no condensation. Thus, among the factors causing condensation the color, or the radiation of the rocks isolated must be considered.

The view expressed in the Mushroom article which is that of current text-books, must be mitigated; the green plants live also on ready-made food, and the mushrooms are certainly not indifferent to external radiation, although their staple function is to live on ready-made food. The colorations which they work out are certainly symptomatic of the chemical processes observed in them. For example: *russula edulis* is good for consumption even in a raw state, while the *russula emetica*, indistinguishable from it morphologically, has a brightly colored cap and stem and is poisonous. Mushrooms of the same species, differently colored, produce different chemicals.

I certainly believe this is a very important line of research for the understanding of the natural phenomena and of great practical importance to our welfare. ●

Panic, Fear, Human Mind

(Continued from Page 2)

situations which can be distorted into religious discrimination.

Propaganda can be stopped by the same methods as rumor. Nothing throws cold water onto gossip more quickly than the comment, "I don't believe that and won't, unless you can prove it."

Morale

If we are to prepare ourselves for possible attack, we must not overlook the very important factor of spirit among the people. Morale is a state of mind. Good morale renders a person capable of endurance; it enables him to stand fast in the presence of danger. Confidence, courage, willingness-to-do, and faith are all a part of morale; community morale is the sum total of individual morale throughout an area. Good community morale will keep this country strong, resilient, and resourceful. You can maintain good morale by:

a) Carrying on a practical, sensible community program which requires the cooperation and companionship of all of the people;

b) Getting the people to understand fully that ALL face the same problem;

c) Making sure everyone realizes that industry must keep rolling if we are attacked, or the military will soon grind to a halt; a country's basic strength lies on its Home Front;

d) Getting them to participate in planning their own defense;

e) Getting them to coordinate their activities towards helping their neighbors as well as themselves; team competition with neighboring towns helps to promote good community spirit.

We can build a foundation for steadiness in the face of desperate disaster:

1) By giving specific assignments of responsibility to as many individuals and teams as possible.

2) By developing an esprit de corps in CD by actual team exercises of growing complexity;

3) By developing faith through each community in the soundness of local Civil Defense preparations, so that in a crisis the local CD leaders will be trusted. ●

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New Books

(Continued from Page 27)

be remarkably free of errors. However, the mass number of the isotope of longest known half-life of berkelium is reported on page 91 as being 345. It should read 245.

Especially useful are the comprehensive index and the numerous cross references. Many great names in American science have contributed to the success of this book, which is not intended to supply complete data in any specialized field, but rather to present only the more commonly used information.

We are sure that the eighth edition of *Lange's Handbook of Chemistry* will prove as useful as the seven previous editions have been.

Martin I. Blake

College Physics

(Second Edition)

- *By* ROBERT L. WEBER, MARSH W. WHITE and KENNETH V. MANNING. New York: McGraw-Hill Book Company. Pp. VIII + 820. $6.50.

The second edition of this excellent text, designed for students of science and engineering, retains the desirable features of the first. It includes considerable rewriting. We note with approval the large number of problems, (some with answers) designed to help the student understand the exact nature of physical science; the numerous charts, graphs, and line drawings that clarify descriptions; the well planned questions at the ends of chapters designed to test understanding of principles; and the clearness and conciseness of the writing. The physical make-up of the book leaves nothing to be desired.

Recent developments in physics are given adequate treatment. The Appendix provides valuable help in solving problems, a discussion of the proper use of significant figures, and derivations involving calculus notation. Brief historical references and biographical sketches help trace the relationship of modern ideas to those formerly held. This text is worthy of careful consideration.

A. K.

The Evolution of Chemistry

• *By* EDWARD FARBER, PH.D. New York: The Ronald Press. 1952. Pp. IX + 349. $6.00.

As its dust jacket states, this interesting volume is a history of the ideas, methods and materials of chemistry. It traces the rise of chemistry from the earliest obscure references to operations in the use and modification of natural minerals, about 3000 B.C., to the dynamic basic branch of science that is chemistry today. It is a well written, well documented, occasionally wordy, but ever engrossing narrative of man's advances in understanding and using the elements in the world about him.

To cover the span of some 5000 years the author uses three broad periods. The first, devoted to describing the emergence of chemistry as a science out of the experiences of workers and artisans and out of the theorizing of the early philosophers, surveys the years up to the eighteenth century. A better understanding of how an exacting science grew out of the hodge podge of superstition, deification, false hypotheses, and attempts to make facts conform to theories that prevailed during this period, gives the reader a new appreciation of the dignity and solidity of modern chemistry as a science. The second period, which tells the story from the emergence of chemistry as a distinct science, to the late nineteenth century when it was broken down into distinct branches, all interrelated and interdependent. The third period, beginning about 1880, is the period of specialization and industrialization with which we are more familiar.

Dr. Farber pictures past events as the result of human reactions, as human efforts to observe and to understand, to produce and to use materials and forces. From the earliest times the development of chemistry has gone hand in hand with progress in botany, zoology, physics, and engineering as well as in pharmacy and medicine. Consequently, this book should be interesting as well as useful not only to students of chemistry and to workers in allied fields but also to all who are interested in the advancement of human knowledge.

William J. Sullivan
Duquesne University '53

Man, the Chemical Machine

• *By* ERNEST BOREK. New York: Columbia University Press. 1952. Pp. XII + 219. $3.00.

A book for every school and public library, well worth its cost. Here is proof that such an involved science as biochemistry can be seriously discussed in the language of the layman without loss of dignity. Dr. Borek, well known biochemist, has wisely refrained from writing a "How wonderful!" book. He uses no exclamation points. He has chosen to show, rather, how the scientist by accident or design discovers and correlates the bits of information out of which he constructs the theories that lead to clearer explanations and new discoveries. A lively non-pedantic style, excellent descriptive powers, and a stimulating use of unhackneyed analogies all make for easy reading. There is not a single chemical formula in the book except H-O-H.

The high spots in the development of biochemistry receive adequate attention, with emphasis on late discoveries. The introductory chapter on the "Stuff of life" leads into a most interesting chapter on enzymes, little known "giant molecules with gigantic know-how." The amino acids and proteins, "the masonry of cells," and the sugars which the cells use as fuel are well described. The reader is told how tagged atoms are used in biochemical research. There are good chapters on blood, "the highway of the cells," on cell defense, genes, and the brain. A final chapter pleads for an increase in the coordinated research efforts of biologists, biochemists and physicists directed to the study of molecular physiology.

H. C. M.

A Dictionary of World Literature

• *By* JOSEPH T. SHIPLEY. New York: Philosophical Library. 1952. Pp. XII + 453. $7.50.

Mr. Shipley's volume provides conveniently within its physical limitations of 453 pages a great deal of that kind of information a teacher in the humanities is bound to use, and it should prove valuable to the serious student of literary history or to the novice in literary criticism whose work will bring him into contact with both standard and exotic terminology. In fact it will not be out of place on the desk of any student who is concerned with human thought.

Here will be found "ecbasis," "gnomic poetry," "French criticism," "imagination," "literature and society," "primitivism," "style," and certainly 2000 other topics, analyzed and defined with encyclopedic brevity. The work has gained in authoritativeness by the editor calling upon a long list of scholars to help him; a wise procedure, for the earlier version was criticized for being sometimes in error and at others inadequate in extent of treatment.

As its title says, *A Dictionary of World Literature* deals only with literature; definitions of terms used in the other arts, even when such terms have literary

significance (see "expressionism") are not given. There has been, probably necessarily, a good deal of eclecticism exercised in the selection of the items to be included. "Humor" as applied to wit and laughter is defined, but, astonishingly, not "humor" in the sense the Renaissance and Shakespeare and Pope used the word. The definition of "higher criticism" is unsatisfactory for it fails to note its significance in the area in which it originated, nineteenth century religious scepticism. "Scholasticism," certainly a literary as well as a philosophical phenomenon, does not appear at all. And, probably wisely, because of the difficulty of doing the job well in a short space, "renaissance" is left out. But why should "court of love," certainly a familiar term in "western world" literature, be excluded?

Any attempt to do in one volume what Mr. Shipley has attempted is bound to result in a certain degree of dissatisfaction, both to the editor and to the reader. The title, *A Dictionary of World Literature*, carries an encyclopedic suggestiveness that 450 pages will not satisfy. But there have to be limits, set by the commercial jobber or the energy of man—of the jobber because of the costs of production, of man because no one is omniscent.

But who is "R.P." who wrote the definition of "classicism"?

J. M. Purcell, Ph.D.
Department of English
Duquesne University

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Handbook for the Chemistry Teaching-Assistant

"You have been selected for the responsible position of teaching-assistant by your college or university . . ."

Thus begins the *Handbook for Chemistry Assistants*, a unique 32-page manual prepared and published by a committee of the Division of Chemical Education of the American Chemical Society.

The book is an attempt to answer a long-felt need in the education world, where a large share of chemistry instruction is borne by graduate and undergraduate student assistants. For these young, inexperienced teachers the new *Handbook* brings detailed, easy-to-read chapters on Conducting A Recitation Period; Conducting A Laboratory Period; Quizzes, Tests, Reports; Safety Measures; and First Aid Procedures, among others.

Although there are interesting broad remarks on the profession of teaching itself, there is, even more, a wealth of practical information such as "gas, water and hydrogen sulfide outlets should . . . be checked on entering and before leaving the laboratory," and safety measures for radioactivity experiments.

The Handbook fits easily into a shirt or laboratory coat pocket.

Copies are available without cost from Educational Service Department, Fisher Scientific Company, Pittsburgh 19, Pa., through whose facilities the book was published.

Polio Facts for 1953

Tremendous recent progress toward a control for infantile paralysis has brought us to the threshold of prevention of the disease. Thanks to the support of the March of Dimes by the American people, scientists are now planning the first field trials of a polio vaccine, and manufacturers are producing the blood fraction, gamma globulin, for limited use as a temporary preventive of paralysis.

Both are good news. Hope rides high.

But despite this, 1953 will see outbreaks of polio; we cannot count on any startling reduction of cases this year. Reasons:

1) the vaccine is *not* here—it has yet to be tested;
2) despite every effort of the National Foundation for Infantile Paralysis, the American Red Cross and government authorities, gamma globulin will be in such short supply it can be given to fewer than one million children out of a population of 46,000,000 in the most susceptible age groups.

We must understand and accept the facts and keep cool heads when faced with the reality of polio. We cannot relax our watchfulness nor ignore the usual precautions yet awhile. If polio comes to your community you will want to observe the sensible rules for good health that have been urged in previous years:

. . . let your children continue to play with their usual companions—avoid new groups;

. . . make sure they scrub their hands before eating, avoid use of other people's soiled towels, dishes and tableware;

. . . beware of fatigue and chilling, which lower resistance to polio virus;

. . . don't subject young children to unnecessary and lengthy travel.

Consult your doctor if your child has any symptoms of polio: headache, fever, sore throat, upset stomach, stiff neck or back—and keep him in bed, away from others, till the doctor comes.

If polio strikes, turn to your local Chapter of the National Foundation for Infantile Paralysis for advice and financial assistance where needed.

Conquest of polio is not yet here—but final victory is much nearer.

★ ★ ★ ★ ★

"We must also recognize that science is a national resource out of which can and must come replacements and substitutes for depleted natural resources. In fact, one of the major responsibilities of science and technology in the years ahead will be the conservation of natural resources and the replacement of scarce materials by equally good or better substitutes."

—James R. Killian, Jr.
The Obligations and Ideals of an Institute of Technology